AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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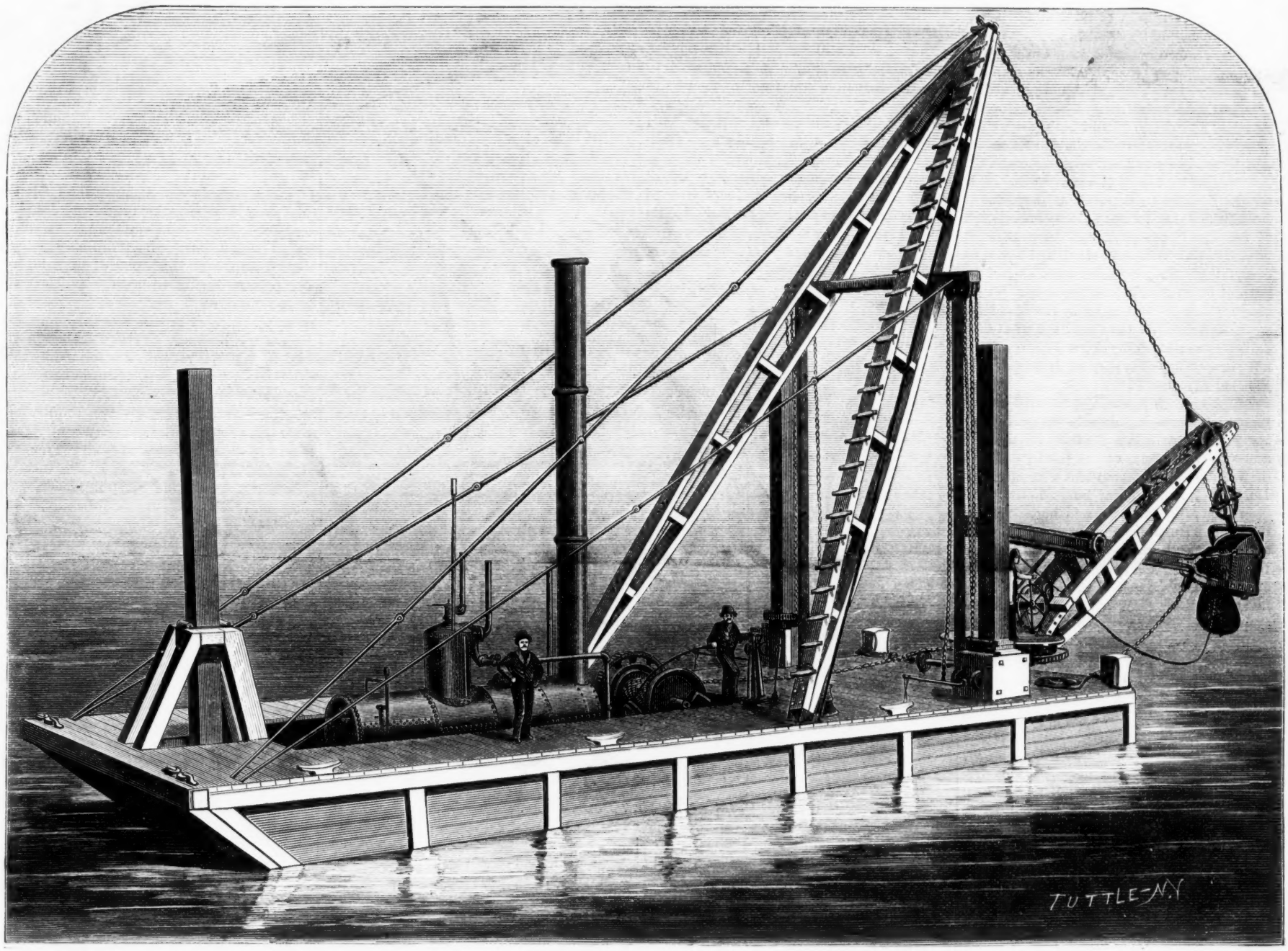


OSGOOD'S IMPROVED STEAM DREDGING MACHINE IN OPERATION.

Improved Dredging Machines.

The application of power to land and under-water excavating has had its share of attention in the field of applied mechanics, and in these days of public river and harbor improvements the readers of the AMERICAN MACHINIST will be interested in the subject of our illustration, which is a dredge or excavator designed and built by Ralph R. Osgood, of Troy, N. Y.

As is well understood by those interested, dredges or excavators employing power are of two general classes, viz., those designed to remove soft material only, like the "clam shell" and "endless chain bucket" machines, and those employed in hard digging which require the more powerful single scoop or dipper.

The Osgood machine is calculated to combine the facility of operation of the first class with the strength and capacity of the second class.

In place of the old form of triangular crane, with its cumbersome crane-post, a light boom is now made to carry the traveling dipper handle, the boom being hinged upon a turn-table and having its outer end supported by suitable chains or cables leading up over an A frame, out of the way of the swinging motions.

The dipper handle is clamped in its working position by means of a friction brake, through the use of which much strain and jar is obviated and breakages prevented.

The boom may be raised and lowered at pleasure, so as to regulate the height at which the load may be dumped, and the hoisting chains pass over pulleys near the extremity of the boom, by reason of which they are made to give a more direct pull upon the dipper towards the bank, thus economizing in consumption of power. For swinging and dumping the load little power is required, and therefore in these movements advantage is taken of the opportunity to deliver the material quickly, and to rapidly return the dipper to its working position on the bank.

The swinging of the boom with its dipper handle, and the load is accomplished by use of the hoisting chains, one on each side, directed by suitably arranged sheaves upon the turn table.

The hoisting chains are operated by independent drums which permit of the simultaneous movement of both chains to drag the dipper into the bank, and also permit an independent motion while turning the load over its dumping point. By thus doing all the work with the hoisting chains, an independent swinging engine is rendered unnecessary.

The boom may be swung around through two-thirds of a circle, as will readily appear from the view, and the arrangement is such that the dredging may be accomplished at any point of this extended arc, thereby diminishing the occasions for shifting the machine upon the bank. Under the arrangement shown, the dipper will cut the bank in the arc of a semi-circle, and the depth of cut may be regulated at pleasure by the rising and falling boom.

The machine is constructed and arranged to operate quickly and smoothly, and to distribute the working strains in such manner that the maximum of power is applied at the point where the resistance is greatest.

The clam shell guide poles may be applied at the extremity of the swinging boom, with only the additional cost for the eyes, and thus the machine is converted from one class to the other at a very trifling expense.

The device herein illustrated embodies all the latest improvements of Mr. Osgood, who has devoted a number of years to the subject, and our engraving is made from a photograph of a dredge in actual operation.

As hundreds of thousands of dollars are annually spent in dredging our rivers, harbors and docks, it is plain that any apparatus that enables such work to be done more easily must save a considerable sum of money.

The Osgood machines are now represented in nearly all the States of the Union, as well as in many foreign countries. Their reputation for capacity, durability and excellence of workmanship in every part remains excellent.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * It is astonishing how much ship-shapeness and order will tend to economy.

An orderly system and strict discipline in the shop is not hard on men. It is just the other thing. It prescribes duties within the power of each man, and thus really lightens the labor of each man. Go-as-you-please work is the hardest kind of work, and the rigid lines of duty, if prudently laid, are always easy to follow.

The opposite of order is disorder and shiftlessness. Shiftlessness in all things results in an accumulation of things out of place. The replacing of these things forms the hard work of life.

* * * * I know of no more terrifying job than cleaning up a machine shop which is only cleaned when it gets too dirty to work in. One or two such jobs is enough, and generally will be so vast and unpleasant as to put a stop to all future cleaning operations. The red rust of an hour's production is easy to remove, but the black rust resulting from two days' existence of red dust calls for a resurfacing of metal work. It is not hard to clean up a clean shop, but it seems impossible to clean a dirty one. Lack of neatness in one place will demoralize all places. This demoralization will show in everything. Tidy machine work cannot be got out of an untidy machine shop. Those shops which let things go by the board for weeks and months, and then have what they call a grand cleaning up, are never clean, not even the day after they are cleaned. The job is too great to be well done.

* * * * Sometimes you will see a planer hand wearing himself out on a cleaning job. He will run the table off the bed and shovel chips out of the inside, and will dig out old oil thick and stiff with cuttings. He takes down bottom boxes and cracks gum off of the journals, and bores out the oil holes. He pulls down the saddle work and wrestles with the down feed miters. His planer is too black to clean decently, and when half done he begins to slouch the big undertaking. When he gets things in shape again he does nice planing for three days, and then the oil holes get plugged up again and chips accumulate, and the miters get on a strike and won't work smooth, and Mr. Planerman begins to get down at the heel all over, and don't pretend to work closer than a thirty-second. Maybe the man right next to him never takes a cleaning fit, and always has a nice clean, tidy planer. This cleaning is really so small a job, when done regularly and well, that you can never catch him at it.

* * * * The dirty machine shop is always complaining of the lack of room. Such shops will continually buy in real estate and cover it over with a heterogenous mass of stuff which if sorted out and put in proper place would not be in the way at all. I always notice that those shops which are always crying for room to stretch their neglect in have ten times more room than common, and are occupying the biggest part of one or two blocks of streets and alleys.

Room isn't the thing needed at all. Order is wanted. Make the decks and hold tidy, and there will be no complaint of lack of room.

* * * * If no men were shiftless some men would starve. I know many men who grow rich in setting to rights the disorders of careless men.

* * * * I have had considerable to do with balanced slide valves for steam engines. In point of principle they are all the same. They take a valve which is unbalanced and hard to pull, and change it into a balanced valve easy to pull. All of them are capable of either balancing, underbalancing or over balancing a valve, so there is no real difference in principle in their action. My private opinion is that all balanced valves for three-port engines, under a hundred horse power are a nuisance, resulting in more loss than gain. If it is an improvement to put a balanced slide valve in an engine it is a still greater improvement to take it out again.

* * * * A common slide valve will consume from two per cent. to six per cent. of the engine power. When a slide valve uses ten per cent. of the engine power it is time to break the engine up into scrap; when the entire friction of a steam engine, including the running of air pumps and feed pumps, amounts to twenty-five per cent. of the engine power, it is time to break something. And still the average balanced valve man will claim that his valve will result in a saving of all the way from twenty to sixty per cent., and more than that he can prove it. He can show a hundred testimonials, perhaps, from parties whose valves he has changed, all bearing testimony to the fact that since the change a certain per cent. saving in coal or gain in power is noticed. Furthermore, most all these testimonials are as true as gospel, given in good faith, on a correct observation of facts, and to deserving men. And still I maintain that the balanced slide valve is by itself a delusion, and that the inventors are real benefactors of steam users.

* * * * Here is a case in point. Mr. Willard had in his flour mill a plain slide-valve engine, eighteen by thirty, with rock-shaft-valve motion, plain patent governor of popular make, two common flue boilers of proper size, and an engineer at thirty dollars a month, who had duties outside the engine room. His coal bill was so large that I won't name the amount.

Mr. Parsons has invented the best balanced slide valve in the world; it saves half the power, you know, &c. &c. Mr. Parsons struck Mr. Willard's mill, and got Willard seriously into the idea of having the rig put in. Willard has confidence in my elegant judgment, so he brought Parsons and his model around to my place, and asked my advice. I didn't pay much attention to the model, but I talked an hour with Parsons and decided that he was smart and understood the business he was in; so I advised Willard to take the new valve, and give Parsons full swing.

* * * * When Parsons was done with his job, he and Willard watched things closely, and Parsons went away with a well-earned certificate—evidencing the fact that the new valve was effecting a saving of forty per cent in coal, and that the power was more steady and satisfactory. In spirit I endorsed this testimonial, and added that Parsons' patent balanced valve was the biggest fraud I had yet seen.

* * * * Now for the facts in this case. Willard is a mean slouch. He neglects all things himself, and only employs the slouchiest of men. He attends to nothing, and don't employ attentive men. In principle he never fills up anything till it gets empty and never empties anything till it gets full. He is one of those shiftless men whose day of reckoning is a day of painful labor. Willard's engine room was just what you might expect of Willard, and Willard's engineer was just the man for that engine room. I really believe that the money which Parsons pumped out of Willard was the first talent money ever spent by Willard.

* * * * So much for Willard. Now for Parsons. Parsons was a long-headed, active, smart mechanic, a man of quick and accurate observation, exceedingly well posted in the matter of steam power, and firm in faith in his clap-trap fraud of a valve.

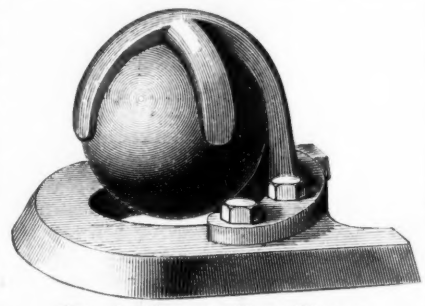


FIG. 4.—RUBBER BALL VALVE.

* * * * He opened Willard's steam chest and got a chart of the valve seat. He went to a machine shop and had one of his valves built to suit that seat. The new valve was an inch and three-quarters longer outside than the old one, and three-quarters longer inside; and he spliced the rocker arm to give the valve motion enough. This much for the steam chest and valve gear. Next he took the piston to the shop and had two days' work done on it. Then he put a line through the cylinder and knocked one end of the guides over three-sixteenths of an inch, and moved the out end of the main shaft seven-eighths of an inch. He had the governor rebored and a new valve put in. He took a choked up little throttle valve out of the steam pipe and put a decent one in. He rounded the crank pin and cross-head pin and shaped up the rod brasses, and relined the eccentric strap and *set the eccentric in the right place.* Then he went for the boiler. He rebuilt the bridge wall and built it right. He put in twelve new grate bars and let them all down fourteen inches. He strained the furnace walls up to place and straightened the fire front and furnace doors up so nicely that you couldn't throw a lump of coal into the furnace if the doors were shut. He put clinker doors at the tail of the grates and showed the men how to fire a boiler. Then he put a fancy brass sign on the steam chest indicating its precious contents, and told Willard to help him watch the coal pile.

The results, you may well imagine, were all that the testimonial stated, and all that the proudest balanced valve man could hope for.

* * * * Willard's engineer had something to be proud of now, and he braced himself up accordingly. He watched things closely, and had no trouble for a month or six weeks, after which time the balanced valve began to cut up didos and make a fuss generally. Then a common slide valve was made *of the same length and travel of the balanced valve,* and since that everything has moved off smoothly.

* * * * Parsons was a good man for the job. His corrective powers, direct and by stimulus, have put many hundreds of dollars into Willard's pockets by savings in coal. Of this saving, Parsons' balanced valve was not entitled to credit for the millionth part of one per cent., and at the same time if there were no Parsons' patent valve, there would be no Parsons to regenerate the shiftless Willards.

* * * * Very respectfully,

CHORDAL.

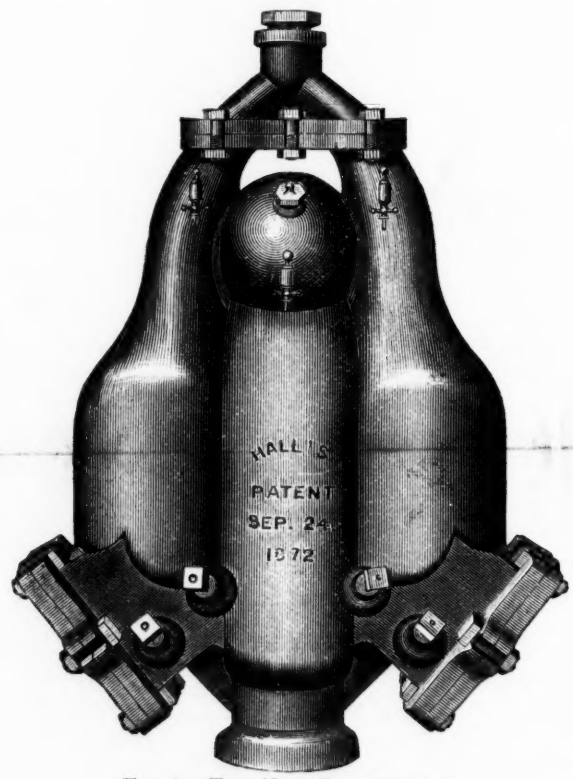


FIG. 1.—THE NEW PULSOMETER.

The New Pulsometer Steam Pump.

Some years ago a new style of pump, or device for raising water, called the pulsometer or magic pump made its appearance. In addition to the possession of certain desirable advantages, such as being able to raise muddy water, which in some instances contained gravel and other matter, that would be destructive to an ordinary piston steam pump, it also had some disadvantages. The principle upon which the pulsometer operates is of very ancient date. Savery's pumping machine in 1698 was similar to the pulsometer, inasmuch as two chambers were used in which a vacuum was formed by the admission of steam, while the pressure of the steam was also used to expel the water. When one of the chambers was filling, the other was being emptied. Thus a continuous stream of water was ejected from the mouth of the forcing pipe.

In construction, the old pulsometer was rude and difficult to manufacture, the casting being in one solid piece. Ball valves were used, which were made of different metals, but generally of solid cast iron. These balls were necessarily heavy, and were placed in the core when the mould was made up. The seats were chilled, and if the work had been performed by a skillful mechanic, the result was a good durable piece of work, but more frequently there were imperfections in the seats which were sufficient to condemn the casting. The balls were thrown violently about and soon destroyed themselves, though, in some cases, they worked very satisfactorily. The small brass ball which forms the steam valve at the top, also the larger balls and seats, after being worn out, were never repaired. This apparatus was also very extravagant in the use of steam, and was, for this reason, objected to by many. In its operation it was very noisy and worked unsteady, at times throwing a broken stream of water. In the new pulsometer, Fig. 1, these and other objections have been fully overcome. Referring to Fig. 2, which represents a sectional view, we will describe its construction. The principal part, or body of the pump, consists of two chambers *A, A*, which have the appearance of two bottles placed side by side, with the necks inclined toward each other, to the top of which is attached (by means of a flange joint, *B*) a continuous passage from each chamber leading to one continuous passage. A small composition ball *C*, is fitted into the passage, and is made to oscillate with a slight rolling motion between two seats formed in the junction. It is so arranged that the ball must remain in contact with one of the seats, and cannot admit steam to both chambers at the same time.

These chambers also connect by means of openings with the vertical induction passage *D*, which openings are so formed that the valves *E, E*, may be easily inserted. These valves consist of pure vulcanized rubber placed upon a special form of seat *F, F*.

The delivery passage *H*, which is common to both chambers, is also constructed so that the valve seats *G, G*, Fig. 3, are placed in the openings that communicate

with each cylinder. These openings are fitted for the reception of the same style of valves as in the induction passage. The valve-guards *I, I,* are to prevent the valves from opening too far.

To facilitate the ready removal of the valves and valve-seats, it will be observed the flanges that cover the openings are slotted to receive the bolts. By loosening the nuts they may be readily removed and the covers displaced. To avoid rust, the set bolts fastening the seats, and the tap bolts holding the valves, are made of brass.

The vacuum chamber is represented by *J*, which is cast with and between the necks of chambers *A, A*, and connects only with the induction passage below the valves *E, E.*

The flanges *K, K*, cover the openings to the respective chambers, and may be removed for the repair or renewal of valves and seats, when necessary. Vent plugs are inserted into these flanges, for the purpose of drawing off the water to prevent freezing.

A small brass air check-valve (see Fig. 1) is screwed into the neck of each chamber *A, A*, and one into the vacuum chamber *J*, so that their stems hang downward.

The check-valve in the neck of each chamber *A, A*, allows a small quantity of air to enter above the water, to prevent the steam from agitating it on its first entrance, and thus forms an air-piston which prevents condensation.

The check-valve in the vacuum chamber *J*, serves to cushion the ramming action of the water consequent upon the filling of each chamber alternately.

The steam pipe is provided with a globe-valve located near the pump, the suction pipe at the bottom with a check-valve placed thereon, and the discharge pipe connected with the discharge chamber. By closing all the air check-valves in the chambers, the pulsometer is ready to operate.

By opening the globe-valve for an instant, the steam will pass into whichever chamber the position of the small ball permits, and displace the air. By closing it, the steam will condense on the walls of the chamber, forming a vacuum. By repeating this operation several times, expelling the air by steam, the space within the chambers will be filled with water through the induction pipe, after which the steam may be regularly admitted. Each air-valve in the chambers must then be opened a little, by means of the milled nut on the stem of each, just sufficient to secure a regular and continuous action, which will be recognized by the steady pulsation and smooth, noiseless working of the steam ball.

As the steam enters the chamber directly above the water, it presses upon and forces it out past the discharge valve, and through the discharge pipe, with a velocity and force equal to the pressure of steam in the boiler to which it is attached.

The new pulsometer requires about the same amount of steam to operate it as the bulk of water it displaces. A No. 5 pump, having a suction of 3 inches and a discharge of 3 inches, requires only a ¾ inch steam pipe. When the water has been displaced by the steam which follows it through the opening to the discharge chamber, the steam will suddenly condense by passing under the water, and the vacuum thereby formed will cause the steam ball to change, thus shutting off the steam, and transmitting the pressure to the opposite chamber, and at the same time induce the water to fill it in place of the condensed steam.

Thus will they alternate, keeping up very nearly a continuous stream as long as there is steam supplied and water to be pumped.

It will, therefore, be observed that the pulsometer, containing as it does no mechanical element, as the friction of a piston, to absorb power, and possessing the advantage of the force of the vacuum in the chambers alternately to raise the water without the expense of power, requires but a small quantity of steam to operate it.

The durability of this style of pump is remarkable, as there are no pistons, glands, stuffing-boxes, rods, bearings, cams, and it requires no oil and has no exhaust steam to be conveyed away.

Every part that sustains any wear is now constructed interchangeable, so that it can be easily removed when worn, and replaced at a trifling cost. It requires no special care, and will, on a constant suction, work day and night without attendance, or as long as steam and water are supplied. The pulsometer is peculiarly adapted for use in chemical works, sugar refineries, tanneries, gas works and breweries, where the wear and tear of a piston pump is enormous. In the pulsometer all the wear and tear is confined to the valves and their seats. For pumping mash in breweries, or pulp in paper mills, the valves described are liable to clog up; and for special cases a rubber ball valve, as represented by Fig. 4, is used. This valve gives a large opening, so that any piece of a substance that will pass the edge of the seat will pass through without blocking the valve. With these valves water may be pumped which contains at least fifty per cent. of mud or sand. For pumping water to the upper part of a building, an air chamber and also a check valve is applied to the forcing pipe. A foot valve is always used upon the suction pipe which relieves the valves of the pump and retains the water when the pump is not in operation. The pulsometer may be worked by exhaust steam in raising water short distances.

The new pulsometer is manufactured by the Pulsometer Steam Pump Company, Wm. F. Kidder, Prest., G. F. Badger, Sec., Geo. W. Laird, Treas., 83 John Street, New York.

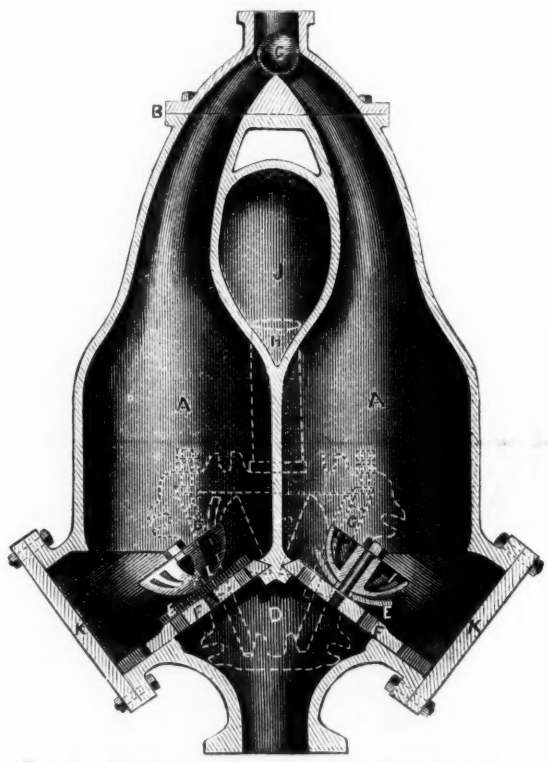


FIG. 2.—SECTIONAL VIEW OF NEW PULSOMETER.

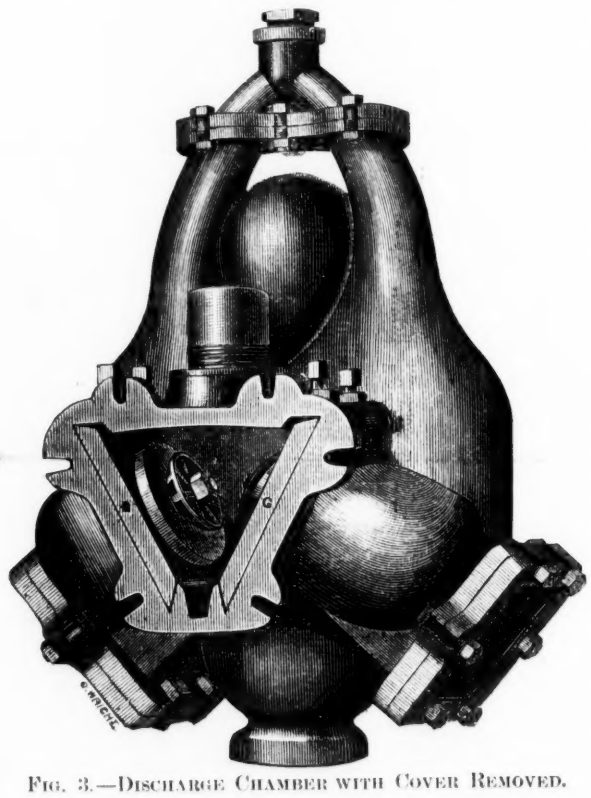


FIG. 3.—DISCHARGE CHAMBER WITH COVER REMOVED.

The number of persons killed in Pennsylvania on all railroads during the year 1879 was 533, and the number injured was 1,581. On the horse railroads in the State for the same period there were seven killed and 22 injured.

Wyman Crow, of St. Louis, who gave $125,000 to the art museum of Washington University, helps also to open the "Manual training school," in connection with the same, the object of which is to give instruction in mathematics, drawing, and the English branches, besides carpentry and general shop work.

Letters from Practical Men.

DRIVING POWER OF BELTS.

Editor American Machinist:

I agree with Mr. Rose that atmospheric pressure may have something to do with the driving power of belts, and my experience leads me to prefer the same amount of leather in a single belt, rather than in a double belt, when possible. But, I would like to have Mr. Rose answer this question,—or first let me quote a little. He says in No. 29, AMERICAN MACHINIST "I do not remember to have at any time read, or heard a reason given by any authority, why increasing the arc of contact of a belt should increase the driving power of a belt *independent of the fact that it increases the bearing area.*" Also:—"the friction increases directly as the pressure, &c."

Now, I ask, if the resultant force of the two pulls of the belt, due to its being strained [one pull each way], is not coincident with the pressure of the belt on the surface of the pulley? And, if this resultant is not theoretically zero when the belt is tangent to the pulley? *i. e.* when the arc of contact is infinitely small; and, it is not at its maximum and equal to the sum of the two pulls on the belt when the arc of contact is 180°? And if therefore, the pressure pince the friction, hence the driving power, does not theoretically vary from nothing to maximum as the arc of contact varies from nothing to 180°?

FREDERIC H. LANE, M. E.

Warren, Maine, July 9th, 1880.

SOME INSTANCES WHERE MACHINISTS HAVE GONE WRONG.

Editor American Machinist:

How often is the turner inconvenienced by the mistaken idea of bent tails on lathe-dogs! The bent tails are sure to be too long, or too short, or too far from, or too near the center; and when finally adjusted, always tend to twist and break the dog, thus causing the whole thing to be made about four times as strong and clumsy as if made straight.

Suppose you have a piece to turn where there is room for a thin dog, but not for a thick one, a crooked dog can't be used. You have hexagonal headed bolts to turn and square up under the head, and you hunt in vain for a special bolt driver right for the job; but if your dogs were thin, with straight tails, none would be needed. Again, there is a pin with a thin head to be turned; you must turn it end for end and make two jobs of it, all because your dogs are too thick. They are so thick, too, that a very short piece would be entirely covered if the dog is put far enough on to drive it.

There are *some* jobs for which we *must* have driving studs in the face plate, and then, thanks to the bent tail dogs, we have to hunt them up, for things seldom used may go astray. But hunting, perhaps, won't find the right hole in the face plate, while the bent tail dogs all around laugh at your fix.

The whole system is a mistake. But how, you ask, should dogs be made? I should say, make them of wrought iron, flat and square cornered, with round boss for a good sized set-screw, the rest being much thinner. For a 3-inch dog, make the screw ⅜ inch, boss 1 inch, and uniform thickness of remainder ½ inch, with a width on radius of ¾ inch. For a 1-inch dog, make the screw ¼ inch, boss $\frac{1}{16}$ inch, thickness ¼ inch, and width on radius ⅜ inch, tail 3 inches long.

As for driving-plates, I would say for a 20 inch lathe, make the largest plate 20 inches in diameter, with a depth of flange and bosses for stud-holes 2 inches; size of holes for long studs 1½ inches, for short ones 1 inch, holes to be distributed at all possible radii; the large holes on one diameter, the small ones on another at right angles. For a small plate, of diameter say 15 inches, make depth of flange and bosses 1½ inches, holes (distributed on two diameters, as before) 1 inch. These plates should have two of the smaller holes so disposed as to confine the dog-tail in cutting screws, when the lathe is run back. These holes should all be reamed parallel, so that the stud may be adjusted to stand out any distance. The plates may have, if desired, additional slats for chucking.

Yours truly,

HENRY W. POND.

SCIENTIFIC EXPLORATION.—A leader in the London *Daily News* says:—One of the most mysterious regions in the world is about to be scientifically explored. An American gentleman, Mr. Lorillard, of New York, and the French Government, have united to fit out an expedition to investigate the ruined cities of Central America. These cities, such as Copan and Pelanque, lie in the territories of Yucatan and Honduras, between the Bay of Honduras, the Gulf of Mexico, and the Pacific. Few of the remains of human industry, few of the monuments of extinct or degraded peoples have roused more speculation or excited more inquiries.

Railway Alarm Whistle.

To prevent the chance of a train running past the danger signal during a fog or snow storm, without the engine-driver seeing it, the Northern Railway Company of France have recently adopted the plan of having a steam whistle on the locomotive, worked by a current of electricity controlled by the signal. The whistle is connected with an insulated metallic brush placed under the engine; and between the rails there is fixed a projecting contact-bar, faced with copper and seven feet long, which is swept by the brush when the train passes. This contact-piece is connected to the positive pole of a voltaic battery, the negative pole of which is in communication with a commutator on the signal post, from which a wire leads to the ground. So long as the signal is at "line clear," the passage of the brush over fixed contact produces no result; but when the signal is set to "danger," the commutator brings the negative pole of the battery in direct communication with the ground, and on the brush passing over the contact, completes the electric circuit, and causes the whistle to be sounded, thereby alarming the driver.

Method of Supporting a Crown Sheet.

BY WILLIAM H. HARRISON.

Sir William Fairbairn, in his most excellent books entitled "Useful Information for Engineers," sets forth the results of his experiments and calculations in a manner which leaves nothing to be desired upon the subjects which he treated, viz.: Strength of Shells, Strength of Flues, and Strength of Stays between Flat Surfaces. He, however, says nothing about the best method of holding up a fire box crown sheet, possibly because in his time the fire boxes were of smaller dimensions than at present. Having at one time in my life given much attention to the subject of boiler stays, I purpose giving my views in this article as to correct and incorrect systems of staying fire boxes. A correct system is one in which, if we take the pressure required to burst the shell as a standard, the flat surfaces will be fully equal to that standard, should the boiler be tested to destruction, and in addition to this, all parts should be allowed to expand and contract under varying pressures and temperatures according to the natural elasticity of the materials, without concentrating the motion resulting from such expansion and contraction to the weak points in the system.

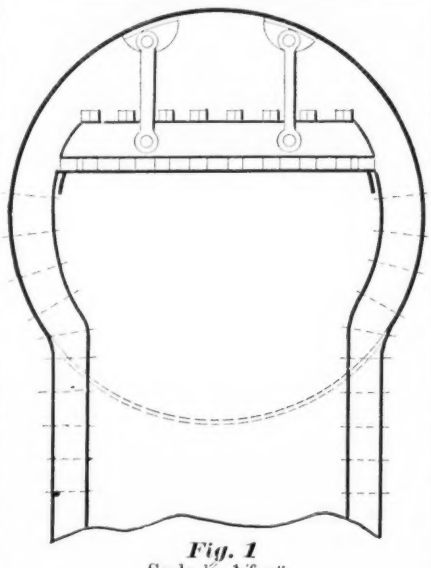


Fig. 1
Scale $\frac{1}{2}$"=1 foot.

The correct system is of course difficult in many cases to attain, consequently we usually find systems which at first sight appear right, but prove to be on close examination, as in the case of the engine Lehigh, quite wrong. In that boiler, as shown in your sketch in issue of Dec. 6th, it appears that a tremendous effort had been made to hold the crown sheet firmly up to the shell, and the effect was, that the bulging out at the sides, being resisted by the upper row of stay bolts, caused the sheet to be so weakened by the continued bending in and out that the accident finally took place as described.

As there may be many persons who doubt that this bulging action really takes place, I will demonstrate it by reference to Fig. 1, which represents the cross section of a locomotive boiler through the fire box. The diameter of the shell is 54" of $\frac{5}{16}$" plate iron double riveted on horizontal seams. Then by Fairbairn's formula, $\frac{50{,}000 \times 7 \times 3}{27 \times 10 \times 80} = 486$ pounds per square inch is the internal pressure required to rupture this shell.

Taking this 486 pounds pressure per square inch, and applying it as our standard first to the flat surfaces of the fire box we find that each stay bolt is required to support a tension due to 476 pounds$\times$25, (the number of square inches) equal to 12,150 pounds. The stay bolt has a diameter at the bottom of thread equal to $\frac{3}{4}$", or a sectional area of .44, and the tension per square inch $\frac{12150}{.44} = 27{,}600$ pounds considerably under the ultimate strength—consequently this part of the boiler is stronger than the shell.

Now, it is probably evident to most minds that a boiler shell having a circular section, on being submitted to a steam or hydraulic test, still retains its form; and the same thing is true of the semi-circular form, provided the flat surface is rigid, and the arched top over a fire box becomes what is called self-supporting, that is, the horizontal components of the pressure are equal to the vertical. But if we draw the sides together by any force, we throw these vertical and horizontal forces out of balance, and the top rises until the forces are again balanced. If we draw down the top with vertical stays then the vertical forces due to the steam pressure become less than the horizontal, and the boiler will bulge out at the sides until the forces are balanced; or if retained by horizontal stay bolts those stay bolts will have a strain put upon them exactly equal to the strain upon the vertical stays.

In Fig. 1 the crown sheet is represented as being stiffened with bars and also tied to the arched top. It is 42" wide and 66" long, and has a surface of 2,772 square inches. The width of the fire box at the lower part is 33", then 33"+33"+66"$\times$66"= 198", the distance round the four sides of the fire box, $198 \times \frac{3}{8} = 75$ square inches section of the metal. If we consider the stays omitted and the crown of the fire box supported by this 75 square inches, it will be depressed an amount proportional to the pressure. The modulus of elasticity for the iron in tension or compression is twenty-five million pounds. The pressure per square inch of surface taken at 486 pounds, $\frac{486 \times 2272}{75} = 18000$ pounds pressure or tension on a square inch of section of the sheet. The fire box is 66" high, which with the 66" of the casing makes 132" length of metal under tension and compression: thus 25,000,000 pounds : 18,000 pounds : : 132" : .09". The last term represents the distance the fire-box crown will settle under the full bursting pressure. Under a working pressure of one-quarter the bursting pressure it will only settle $\frac{.09}{4} = .022$, and the top row of stay bolts would be bent down that distance; and if these stays are not too large and stiff, it seems likely that no injurious effects would result. On the other hand, if we have our stay bolts 5" apart, with a diameter of $\frac{3}{4}$"=.44 square inch section, and twelve of these stays each side in the top row, we will have, when the working pressure is at 120 pounds, $\frac{2272 \times 120}{24 \times 44} = 25{,}800$ pounds tension per square inch section of stay bolts, in case we stay the crown to the arch top. But 25,000 pounds tension on a square inch section of a bar of iron is far too great even for a dead load. Therefore it appears, that of the two methods examined it would be better to omit the hanging stays altogether and rely upon the crown bars, which is, in fact, the method adopted by many of our most experienced locomotive superintendents.

Crown bars, however, are bad, although a very elegant arrangement, is illustrated in the AMERICAN MACHINIST of July 3; and I accordingly append a sketch of a boiler which I designed for a tug boat several years ago, in which I hit, as I think, upon the correct theory of staying, viz.: *to make the outside casing of the fire box parallel to the fire box.* Mr. Woodward, in issue of March 20th, got the thing right, except that he made the crown sheet to conform to the wagon top.

The boiler was only designed for a working pressure of 50 pounds, and the engine (condensing) to indicate 80 to 100 H.P., with natural draught, using salt water for feed.

Referring to Fig. 2, the principal points may be noticed without further explanation.

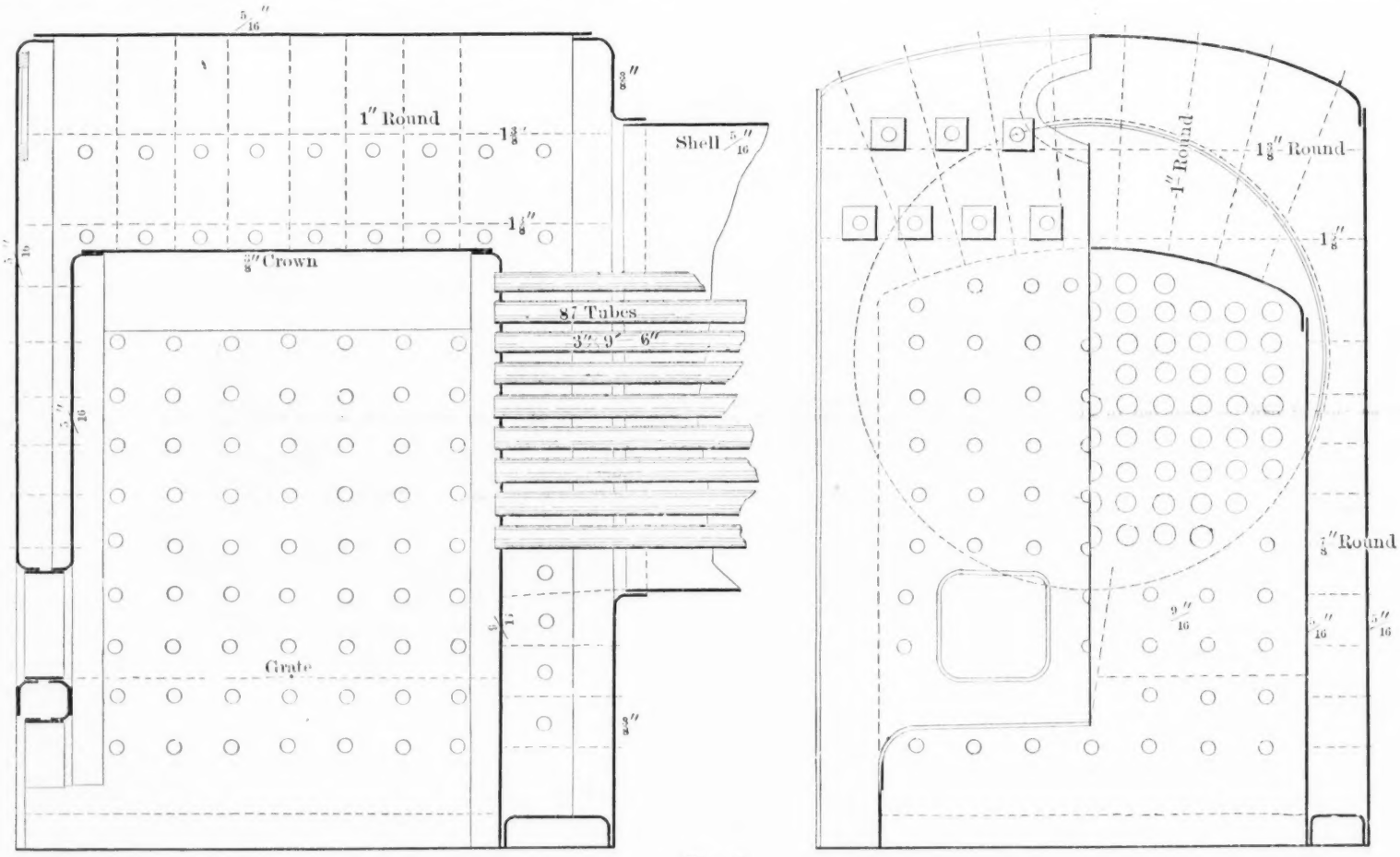


Fig. 2
Scale $\frac{1}{2}$"=1 foot.

Sticking to his Engine.

One day recently, as train No. 513 of the Philadelphia and Reading and Bound Brook line drew out of the Ninth and Green streets depot, Philadelphia, on its way to Ocean Grove and Long Branch, it was fifteen minutes behind time because of the delay by numerous excursion passengers. The train was still behind time when it came on the Bound Brook division, and engineer Bernard Munn, of the Central Railroad of New Jersey, determined to make up the lost time. When the train was running at full speed, between Crawford and Rozell, the connecting rod on the engineer's side of the engine broke directly across the center, between the large driving wheels. The ends whirled with frightful rapidity with the wheels, the front section cutting like a knife through the foot boards and the hind section breaking through the floor of the cab. Engineer Munn, without thinking of his own danger in the cab, shut off the steam, put on the air brakes with full force, and then called to his companions to follow him on to the boiler, out of the way of the whirling pieces. The train was under control within 200 yards after shutting off steam. The broken rod was taken off, as was also the rod on the other side of the engine, and in eight minutes after the train started on its way again, running with only the piston rod and crank to the small wheels.

The Wooden Hat.

Somewhere, about the year 1780, a traveling mill-wright, footsore, and with the broadest Northern Doric accent, stopped at Soho, the engine factory of Boulton & Watt, and asked for work. His aspect was little better than one of beggary and poor looks, and Boulton had bidden him God speed to some other shop, when, as he was turning away sorrowfully, Boulton suddenly called him back.

"What kind of a hat's yon ye have on your head, me mon?"

"It's just timmer, sir."

"Timmer, me mon; let's look at it. Where did you get it?"

"I just made it, sir, my ainsel."

"How did you make it?"

"I just turned it in the lathie."

"But it's oval, mon, and the lathe turns things round."

"A, weel! I just gar'd the lathie gang anither gait, to please me. I'd a lang journey afore me, and I thocht to have a hat to keep out water, and I hadna' muckle siller to spare and I made me ane."

By his inborn mechanism the man had invented an oval lathe and made his hat, and the hat made his fortune. Boulton was not the man to lose so valuable a help, thus the after famous William Murdock—the originator of locomotives and of lighting by gas—took suit and service under Boulton and Watt, and in 1784 made the first vehicle impelled by steam in England, and with the very hands and brain-cunning that had produced the "timmer hat."

New Twist Drill Grinding Machine.

An engraving herewith represents a new automatic twist drill grinding machine just brought out. The machine is mounted on a pedestal as shown in the cut. The table is movable on the vertical slide by means of a lever. It is balanced by a counterweight, as shown on the right. Moving the table presents the drill to different parts of the cutting face of the wheel, and by a little care the wheel can be kept true without the use of a diamond. The wheel has a bonnet carrying a water receptacle, and conductor which distributes the water to the face of the wheel. The waste water is carried off by a drip-pipe to the can shown in the cut. The bonnet is so arranged that it can be moved back as the wheel wears.

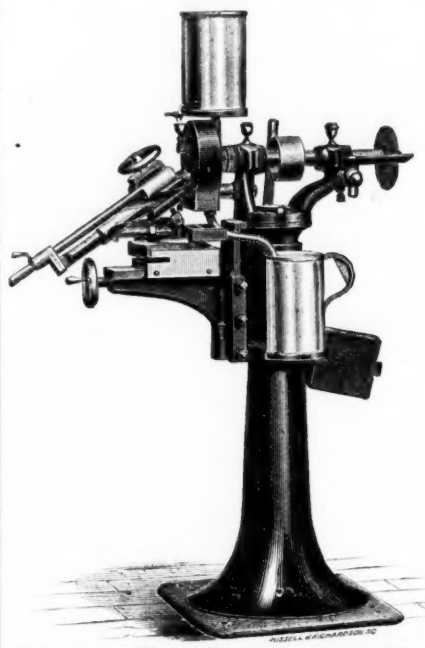
The drill is held by a chuck or holder. The jaws in this chuck are self-centering and are moved by a right and left hand screw actuated by a hand-wheel. The chuck is pivoted to a standard at the back (not shown in the cut) so that it can be revolved in a vertical plane. The base of the standard is pivoted to the carriage so that it can be revolved in a horizontal plane by the handle shown at the extreme left of the cut. These revolutions give the clearance which can be regulated as follows: A cross-slide, not very distinctly shown in the cut, has links connected with it. When the slide is so placed that this connection is concentric with the center of revolution of the standard, the links do not act, and the amount of clearance is governed by the distance between the center of revolution and the face of the wheel. If the slide should be moved to the right, the connection is made eccentric with the center of revolution. The shank of the drill is raised as the standard revolves, thereby crowding the heel of the drill harder on the wheel and giving more clearance.

The carriage moves to and from the pedestal on the slide, as shown, motion being given by the hand-wheel, shown at lower left hand side. Motion can be limited by check nut on the side opposite the observer.

The small wheel on the right is intended to be used in thinning the points of the drill, which become thicker as they approach the shank.

To grind a drill the handle is placed at the extreme left. The drill is then clamped between the jaws with one cutting lip vertical bearing against, and extending a little beyond, a guide not shown in the cut. Drills from $\frac{1}{2}''$ to $1\frac{1}{2}''$ in diameter should project beyond this guide enough to secure the necessary stock for grinding without cutting the guide; larger drills should project from $\frac{1}{4}''$ to $\frac{1}{2}''$. The stop, near tip of handle, is then moved up against the shank of the drill and fastened. The machine being started, the carriage is moved forward until the wheel begins to cut. The handle is then swung to the right until the face of the drill is clear of the wheel. It is then swung to the left again, until the swinging base bears against the stop, and the operation repeated; the carriage being moved forward as fast as the stock is removed, until a perfect cutting edge is obtained. The check-nut is then placed against the carriage and the carriage run back. With the handle at the extreme left, loosen the jaws of the chuck and turn the drill half round, or until the second cutting lip is in the same position as the first was, which is determined by the guides. The second lip is then ground in the same way as the first lip until the carriage is stopped by the check-nut. The lips are now of the same length and have the same angle with the axis of the drill.

In the above operation the cross-slide has been at the zero mark. This position will in



AUTOMATIC TWIST DRILL GRINDING MACHINE.

most cases give sufficient clearance. If for any reason more clearance is desired it can be obtained as follows: With the handle at the extreme left, move the slide to the right. This will change the angle of the cutting lip, which must be readjusted. One of the series of links is an extension link and this is now lengthened until the mark on the chuck holding the drill coincides with the mark on the standard. When the handle is swung to the right, the shank of the drill is raised and the heel of the drill pushed forward, thereby securing more clearance.

The spindle is of steel and provided with improved bearings, so designed as to secure a firm and steady motion to the wheel in operation. The machine, which is well built, is arranged for drills $\frac{1}{8}$ to 2 inches diameter. With extra jaws, drills to $\frac{1}{4}$ inch diameter can be ground. The machine is manufactured by The Morse Twist Drill & Machine Co., New Bedford, Mass.

An English journal says: "A Yankee will buy a machine, work it to death, sell it, and buy an improved one. A Briton will buy one, work it carefully, patch it up until it has cost more in repairs than its original price, and have it in good working order at the end of thirty or forty years." The British practice is no doubt economical (after a fashion) and commendable, but the other is the most profitable, and as the very object of using machinery is to expedite production and to make money, we strongly recommend a trial of the American plan.

The Wear of Metal Bearings.

BY JOSHUA ROSE, M. E.

There is an element in the wear of bearings that I do not remember to have seen mentioned by the authorities upon that subject. Some years ago my contracts included the fitting of 1,000 axle brasses and some hundreds of connecting rod and coupling rod brasses. In a great many cases I put them in new and replaced them when worn out, and having kept at the time a record of the dates of fitting and renewal, as well as of the shapes of the brasses, I formed certain theories concerning some of the reasons why brasses in some situations wear out more rapidly than in others independent of the lubrication. I have unfortunately lost the memoranda, hence cannot give the precise shapes of the brasses that wore out the most rapidly, but the main facts are sufficiently impressed upon my mind to enable me to present them for consideration.

First, however, let me remark that I was under a very sharp competition in getting the contracts which were let in quantities of from 6 to 8 brasses in each contract, and this competition caused me to watch closely the whole of the manufacture of the brasses, especially as they were mostly chipped and filed into their places; and as the axle brasses weighed in some cases as much as seventy pounds, the least defect in the shape of the casting caused much extra hand labor and hard work (planing the brasses being more costly, and taking a longer time was not to be thought of). One of my first moves was to try and get castings more nearly of the shape of the boxes, for I found all the brasses for axle boxes, no matter what their shape, were short of metal just where it would require the most work to bring them to bed well. Thus in a brass, such as shown

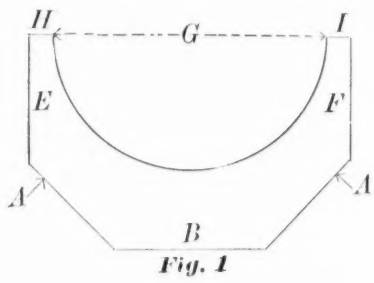


Fig. 1

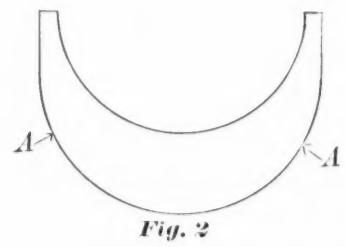


Fig. 2

in Fig. 1, there would not be sufficient metal at *A A*. Now suppose that when the crown *B* of the brass met the box bottom, the point *A* lacked $\frac{1}{16}$ of an inch; then from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch would require to be clipped off *B* to bring *A* up, according to the angle at which *A* stood to *B*. In a brass shaped as in Fig. 2 the same rule holds good. Thinking to remedy this defect, I had a male template made to fit the box pattern and made therefrom a female template with which to have the brass pattern fitted; but this did

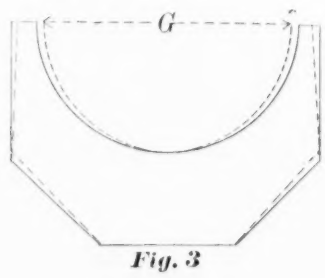


Fig. 3

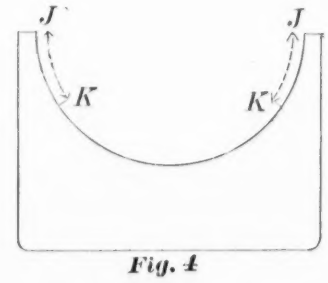


Fig. 4

not mend the matter, for a brass pattern of the form shown in Fig. 3 always gave a casting formed as denoted by the dotted lines in the figure, the bore of the brass closing across *G*, while cooling in the mould. In connecting rod brasses of six inch bore I found the same fact to exist, and I believe this rule to hold good in all castings having a semicircular concave side. In brasses of small bore, the shake or rapping of the pattern in the sand I found to make up for this shrinkage.

As a result I had from $\frac{1}{8}$ to $\frac{1}{4}$ inch cut from the crown *B*, Fig. 1, of the brasses (according to the angle of *A* to *B*) which remedied this difficulty. I next found that the sides *E F* would not fit the boxes so tightly after the brass was bored as before, or in other words the boring caused the brasses to close across the bore at *G*, Fig. 1, and this had to be allowed for in the fitting, but I found that the shrinkage, both in the casting, and from the boring was less in proportion, as the thickness of the brass was greater at 4 and at *I*.

In examining the old brasses when worn out I always found their sides *E* and *F* to have become loose in the box, and as there is no motion of the brass in the box I concluded that the brasses closed in the same direction from wearing. In some cases in which axle brasses were very thin, as, say, $\frac{1}{8}$ inch at *H* and *I*, I found it necessary to use a hammer vigorously to get the brass off the journal, and when a box heated, all that was done was to cut away by a light chip or by heavy filing the bore of the brass, from *J* to *K* in Fig. 4 on both sides, and smooth the rest of the bore if cutting had taken place. Now it appears to me that this is all to be accounted for from the conditions under which an axle brass operates. Thus the bedding surfaces of the box are subject to jars and vibrations under heavy pressure, and this has the effect of condensing and stretching the metal which would naturally cause the bore to close at *G*, Fig. 1, gripping the journal and causing undue abrasion. The surface of the bore of the brass does, it is true, receive the same shocks and pressure, but is more freely lubricated in the first place, and in the second it is being continually removed by wear, whereas the bedding surface remains, and its condensation and stretching is, therefore, augmented by this continuous action. In connecting rod brasses having a circular bedding I found the same facts to hold good, but in a modified degree. But in brassss having a flat bottom bedding, this evil is to a great extent, though not wholly, avoided.

The Shields pumping engine, intended to force the water into Eden Park Reservoir in Cincinnati, developed in a recent trial enormous strength, and worked easily. The steam cylinder is 100 inches in diameter, and twelve feet stroke, working a pump twelve feet by forty-six inches, and lifts and forces two thousand gallons of water at each revolution. The engine was designed by George Shields of Cincinnati, and was built by mechanics of that city. It attracts a great many visitors.

Prof. Thurston, testing pieces of the wire cable of the Fairmont Suspension Bridge, recently taken down at Philadelphia, after being in use about forty years, found the iron to be fully equal in tenacity, elasticity and ductility to the best wire of the same size found in the market. This fact and similar results obtained by another experimenter in 1878, led him to the important conclusion that iron subjected to the ordinary strains of properly designed bridges does not deteriorate with age.

TRICYCLES FOR POLICEMEN.—A somewhat novel use is about to be made of the tricycle at Coventry, England. It is stated that their adoption as a means of transit will enable inspectors of police to get to their different beats at night without the delay necessarily occasioned by their proceeding thither on foot; while it will also expedite the serving of summonses in the outskirts of the city.

Of all places to ride bicycles a newly-plowed field is the best. The rider of one on such premises would be morally certain of not getting hurt when the animal lay down with him.

Automatic Bolt Cutter.

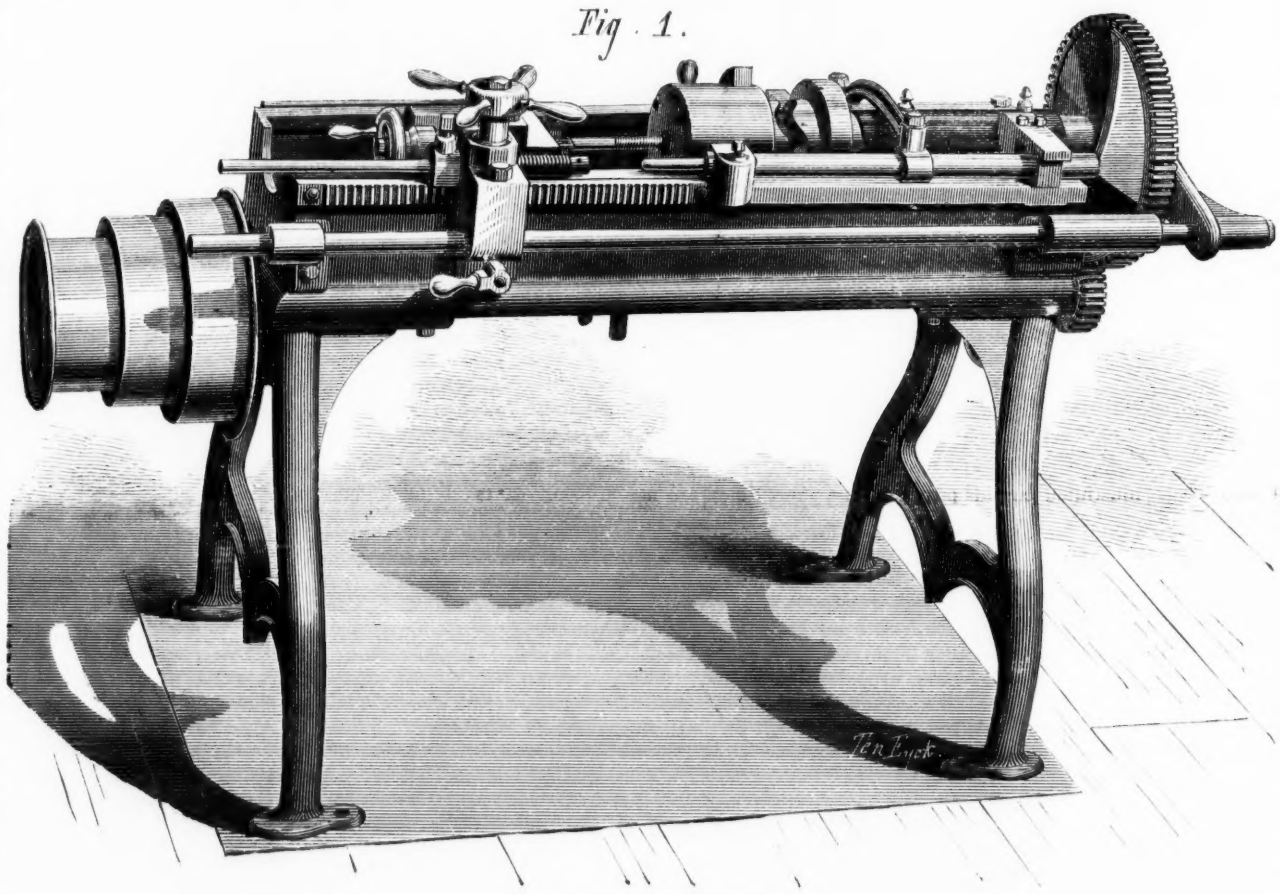
It is a matter of very high importance in the machine shop to cut threads upon bolts so as to insure accurate fits in finished work. The threads are often chased in a screw-cutting lathe requiring the services of a skilled workman. Even then it is almost impossible to thread any number of bolts to exactly the same diameter. The process is, therefore, comparatively imperfect as well as slow, and far from economical. In the bolt cutter represented in the accompanying cut, centers are provided for holding the work exactly as it is secured in lathes. The finished bolts are thereby retained with axial accuracy, and may be threaded by the dies with the certainty of the line of the thread having correct relations to the axial line of the piece. The bolt to be threaded is first centered and turned in the usual manner, as if to be cut in a screw-cutting lathe. It is then placed on the centers of the machine, and, guided only by the longitudinal movement of the movable center and the carriage, is run into the dies. For different lengths of bolts, the arm, in connection with the carriage, is disengaged from the bar, and the carriage is moved to the desired relative position and again secured.

The bolt is arranged upon centers, between the roughened faces of two cams, which are adjusted by two slides, relatively to the diameter of the piece. The tendency of the bolt to rotate with the cutting device, causes, by contact, a corresponding motion of the cams which finally, by their shape, offer a rigid resistance, and thus firmly hold the work.

By the aid of the machine it is claimed that an ordinary hand is capable of threading bolts as accurately and nicely, and with greater precision in size and fit, than the most skillful workman with a chasing tool in a lathe, also that from six to ten times as many bolts can be cut in a given time as by the last mentioned means.

The securing of perfect uniformity of size is a valuable consideration and not to be overlooked by reason of the extra rapidity in operation possessed by some machines. Another feature of merit in this machine is the automatic arrangement by which the dies, after being set to the desired length of thread, are instantly opened at that point, and the bolt-carrier thrown back to receive a new bolt. This arrangement, besides insuring uniform length of cut, avoids the danger of accident or breakage owing to running the holder against the dies, through inadvertence or inattention of the workman. One operator, through this device, readily keeps two or more machines continually at work. This bolt cutter is manufactured by Wood & Jenneson, Worcester, Mass.

Fig. 1.



AUTOMATIC BOLT CUTTER.

The judges on turbine water wheels, at the Millers' International Exhibition, reported their inability to decide as to the best wheel without a practical test, and it being impossible to give them such test at the Exhibition, it was decided that no award be made.

The use of cotton seed hulls as an economical substitute for waste in packing axle boxes was strongly recommended at the recent convention of purchasing agents. It is being extensively tried with practical success.

Practical Draughting—Gearing.

(Continued.)

BY T. P. PEMBERTON.

On reference to the table of diametral and circular pitch, it will be observed that the circular pitch of the first few numbers may be properly considered as among coarse pitch wheels, and therefore the statement, "Wheels of this description generally have their teeth cut in a gear-cutting machine," etc., may be modified by saying that wheels of medium and fine pitch are generally cut in a gear-cutting machine.

The improvements in gear-cutting tools allow the teeth of wheels of medium pitch to be formed far more exactly, by a revolving cutter than when cast from a pattern. In England, the Manchester principle is not, if we remember right, carried beyond four per inch. The rule, at one time, for proportioning the teeth of fine gears, and practiced by some celebrated makers of flax and cotton machinery, was: Divide an inch into the same number of equal parts as the diametral pitch; set off one of those parts above the pitch circle, one and a half parts below the pitch circle, and thickness of tooth equals also one and a half parts. For example: To proportion teeth for wheels ten per inch, one inch would be divided into ten equal parts, then one-tenth would be set off above the pitch circle for the upper part of the tooth, and one and one-half tenths below the pitch circle for the lower part of the tooth, and the thickness also one and a half tenths. This proportion gives a good deal of clearance; but in machinery operating upon dusty and fibrous materials, this clearance was found necessary to prevent the spaces from being clogged up with refuse. Most of the wheels, fine as they were, were cast from patterns, and the teeth merely cleansed by brushing and slight filing.

There are boxwood and steel scales to be had by which the diameters of pitch circles for wheels on the Manchester principle can be measured off at once.

The modern practice is to have the teeth of all wheels of fine pitch cut in a gear-cutting machine whenever smoothness and accuracy of operation are required. Among the best examples of a large system of "machine-cut gears" are those on the large "lightning" and other printing presses constructed by R. Hoe & Co. of New York; on the machine tools constructed by Whitworth & Co., of England; Sellers of Philadelphia; the Pratt & Whitney Co., of Hartford, and Brown & Sharpe Manufacturing Co., of Providence, R. I.—firms who have given especial attention to the construction of fine gear wheels, and have invented beautiful mechanism for ensuring accuracy in their operation. The student will do well to observe the form of teeth in wheels by these makers.

Next in order are the proportions and the calculations connected with gear wheels of *coarse* pitch. The "setting out" or drawing of teeth requires extreme accuracy, and before attention is given to the delineation of sections, plans, side and front views of a spur, and a bevel wheel, the student must know what the essentials are in draughting them. We are aware that this subject of gearing has received much attention from able mathematicians and mechanics. Numerous elaborate treatises have been published about it, some of them only intelligible to expert mathematicians; but there are also other systems introduced by thoroughly practical engineers, which enable the formation of the teeth of wheels to be done in a simple manner. But after all that has been said and done, a variety of opinions exist, and there may be those who can show a still more excellent way.

Reference being made to the last diagram, representing two contiguous teeth of a wheel and bearing in mind the nomenclature connected with it, we now give certain proportions for teeth of wheels.

Let the wheel be of any required pitch; then for proportions of tooth—

From periphery to pitch line = $\frac{3}{10}$ths of pitch; working depth = $\frac{6}{10}$ths; bottom clearance = $\frac{1}{10}$th; whole depth = $\frac{7}{10}$ths; width of space = $\frac{6}{11}$ths; thickness of tooth = $\frac{5}{11}$ths.

Another proportion: — Divide the pitch into 15 equal parts; then from periphery to pitch line = 5½ parts; depth from pitch line to root = 6½ parts; whole length = 12 parts; working depth = 11 parts; thickness of tooth, arms and rim = 7 parts; width of space = 8 parts.

Proportions for wheels with flat arms in the middle of the ring, and ribs or feathers on each side:—The length of the teeth = $\frac{6}{5}$ths of the pitch, besides clearance, or $\frac{6}{7}$ths of the pitch, clearance included.

Thickness of the tooth.....	$\frac{4}{6}$ the pitch.
Breadth on the face.....	2½ "
Edge of the rim.	$\frac{4}{6}$ "
Rib projecting inside the rim...	$\frac{4}{6}$ "
Thickness of the flat arms.....	$\frac{4}{6}$ "

Breadth of the arms at the points=2 teeth and ¼ the pitch, getting broader towards the center of the wheel in the proportion of ½ inch to every foot in length;

Thickness of the ribs, or feathers, ¼ the pitch;

Thickness of metal round the eye, or center, $\frac{7}{6}$ the pitch. For wheels made with plain arms, the teeth are in the same proportion as above; the ring and the arms are each equal to one cog or tooth in thickness, and the metal round the eye same as above in feathered wheels.

To find the breadth of the teeth:—Divide the horse-power by the velocity of the wheel at the pitch circle, per second in feet; twice the quotient is the breadth in inches. Example—Required, the breadth of the teeth for a first mover from a 15-horse engine; the velocity of the wheels being 6 feet per second. Answer:—$\frac{15}{6} = 2.5 \times 2 = 5$ inches.

Industrial Education.

The intensely practical tendencies of the present age have led us to view and judge all questions of political and social economy from the standpoint of want, cost, and value. To these practical tests, education, as well as everything else, must be submitted. Prussia's motto is: "Whatever you would have appear in a nation's life you must put into its schools." If this is true, the only way to meet the wants of the nation is to introduce industrial training into the public schools, from the lowest to the highest grades. Experience proves that it is far better to teach the child a trade in a free industrial school than it is to teach the man in the penitentiary, for about ninety-two per cent. of our criminals are traceable directly to the unskilled and uneducated laboring classes. There is not only a great lack of the intelligent ability to shoe a horse, handle a plow, or engage in any mechanical occupation, but there is an enormous waste of time and material and wealth. We need the skill in all vocations which, in the iron workers' art, transforms $5.00 worth of iron into $10.00 worth of horseshoes, pen knife blades worth $3,000, $29,000 in shirt-buttons, or a quarter of a million dollars in balance-springs of watches. America has now about seventy-five scientific professional schools, while twenty years ago Germany had more than two hundred such schools affording to each person an opportunity of obtaining technical instruction in some useful branch of industrial labor. America's mistakes in education have made her, to too great an extent, a consumer instead of a producer in the departments of industrial labor. These mistakes may be most quickly and thoroughly corrected by general introduction into our schools of both the principles and the practices of industrial labor.—*H. S. Lord, in National Journal of Education.*

The experiments in canal steamboats promise to be a success. Baxter steamers were not sufficiently remunerative to continue the building of that kind of boats. They do not carry a sufficient load, owing to their build, and that is made necessary by the form and arrangement of the machinery and propelling power, the propeller being that form used by the tug in Buffalo. The new style, which bids fair to pay handsomely, is as full a bow and stern as the ordinary first-class canal boat. The propelling power is radically different from the tug propeller. The wheel is eight feet in diameter and placed

close to the stern; the boiler is upright, with a single engine, very compact machinery, taking up no more than the stable in many boats, and enabling the boat to carry 7,500 bushels of corn, and coal for the trip. With this cargo they run from Buffalo to New York in seven days on five and a half gross tons of coal, saving river and harbor towing. One returned from New York to Buffalo in one hour less than seven days, bringing one hundred and thirty tons of freight. The outlook now promises to supersede mule and horse towing. The Belgian system of cable towing will take that large number of boats now relying on the mule, and deliver them promptly as consigned, and in much less time and cost than can be done by the mule. Both systems are necessary for rapid movement on the canal, and to cheapen the transfer from the west to the seaboard. Steam is sure to supersede animal power on the canal, as everywhere else. The canal steamboats are at last so far perfected as to insure a handsome profit in running them, and a large number will soon be at work on the canal. Two are to be constructed in Lockport as speedily as possible by one of our most enterprising boat builders, and the machinery is contracted for, thus opening up a new industry for our numerous and worthy mechanics—[Lockport (N. Y.) *Journal*.

Brown Paper Drawings.

BY EGBERT P. WATSON.

An inventor comes into a machine shop and says he has at last invented a perpetual motion, and would like to have a machine made. The boss of the shop would as soon make a living by that kind of business as any other, and says so; and after announcing that his terms are $250 down, and weekly cash payments thereafter, as guarantee that he won't abandon the enterprise when it only needs three more gears and eight fly-wheels to make it go on forever, he asks for drawings. The inventor says he hasn't made any drawings. He isn't a draughtsman; and of course couldn't trust so valuable a machine on paper in its entirety; but he can sketch, and as he has the plans all in his head, he will draw them out as he wants them made.

"There!" he says; "make me a pattern like this." (See sketch.)

The pattern maker turns white and faintly says, "How thick is it here?"

"Oh, about half an inch!" says the inventor, "but not all the way. Where you see that square prong on one side, it is only an eighth of an inch."

"Is it flat all over?" says the pattern maker.

"Not by any means; don't you make it flat. It is kind of bowing where those three bosses and the beaver's tail sticks out."

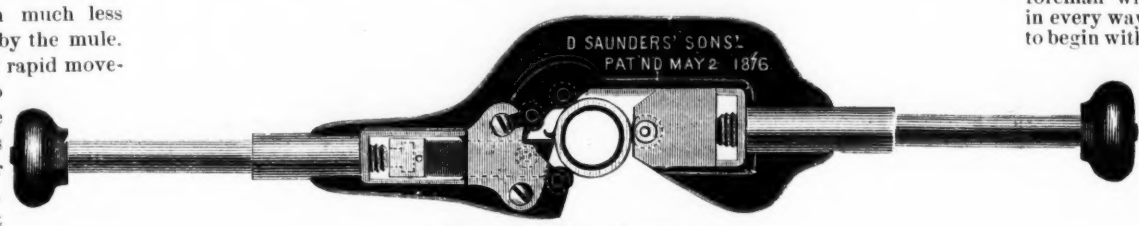
"Which one of these lines shall I go by for the shape? Does it make any difference what size it is anywhere?"

Then the inventor gets angry. He tells the man he thought he was a pattern maker, and he goes off to the boss and asks him for another one who can understand a free-hand drawing when he sees one, and has some mechanical ideas about him. The boss don't want to lose the $250 put up, so he humors the man; and between the whole shop something is contrived that suits the inventor.

Then come the lathe man, and the planer man, and the vise hand, for their share of the fun. Between them all they produce unknown forms that have no resemblance to anything anywhere; things which the inventor himself cannot tell where to connect, or what to do with. There are shafts that have counter-weights that are in the way of moving parts; gears that won't gear with the pinions they are to drive by two inches, and divers other abortions that weigh down the spirit and oppress the soul of the whole shop for months after. Finally when the $250 appropriation is exhausted, the boss says he don't believe in perpetual motion, and won't have anything more to do with it.

This fable teaches, or preaches, the old truth that what is worth doing at all is worth doing well. It is not alone the amateur mechanic who sins in the manner above set forth. In pretentious shops too often the foreman sets the example of hap-hazard slovenly work that encourages the men to do likewise. It is far easier to do a thing right than to do it wrong. 'Tis the voice of the sluggard that says, "It is good enough"—meaning thereby that it is not properly done. The slouch has no time to make drawings, but he has whole weeks to spend cutting and carving over his guess work, trying to make it come in and work well, fitting one piece to another. Brown paper drawings are free hand sketches on the backs of file-wrappers, flaps of envelopes and tail-ends of bills. They have no sizes on them. They resemble the product required as much as a squash resembles a flute. They look, generally, like a map of South America, but out of such material men are expected to evolve the ideas of inventors!

The inventor and the mechanic are two different persons—the one conceives certain combinations which he wishes made. It is nothing to him whether they are mechanical or not; he strives for a result, and the derangement begins when scratchy drawings are presented that cannot be worked from.



PIPE AND TUBE CUTTER.

Pipe and Tube Cutter.

Many devices are in use for cutting wrought iron and brass tubes, and the tool illustrated on this page has, in a short time, gained much popularity for this purpose. Its prominent features are simplicity, strength and lightness, and readiness of adjustment to different sizes of pipe. It operates equally well on solid iron or the thinnest brass or copper tube. There are two handles, one to operate the tool, and the other the central sliding roller. The stock is open on the side to admit the pipe, and is provided with friction rollers, which encircle the pipe, as shown by the dotted lines—thereby producing a rolling instead of a sliding motion, and lessening the friction on the pipe.

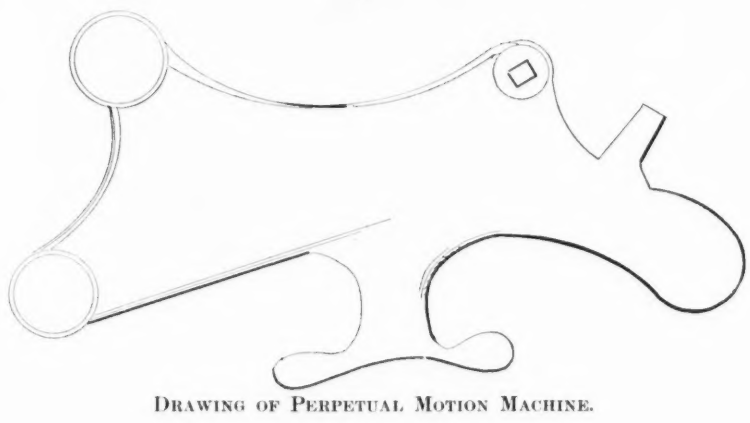
It is a tool cutter precisely similar in action to that of a lathe tool—cutting chips out and leaving the end of the pipe perfectly square and true, entirely void of any burring inside or outside, and ready for the die without being touched with a file.

The central roller in the sliding block is constructed with a small V near the end, which, when pressed on the pipe, indents it, and by turning it round forms a small groove in the pipe—thus preventing the whole cutter from moving endwise, one of the great troubles usually experienced with this class of tools.

It does not depend upon force to perform its work, thus removing any liability to crush or reduce the diameter of the pipe; and the tool working on the side, ⅓ or longer pieces can be cut off, which renders it especially valuable on repair work.

The sliding block and rollers are so arranged that they cannot drop out or be mislaid, and the tool can be easily removed and reground.

This pipe cutting tool is manufactured by D. Saunders' Sons, Yonkers, N. Y.



DRAWING OF PERPETUAL MOTION MACHINE.

Learning the Machinist Trade.

One of the most important industrial questions before the people of this country is, "What effective system is best to adopt to educate boys as mechanics?" If their parents or guardians are able to pay liberally for such education, the question is not so difficult to answer. The problem then resolves itself into a choice, as with Chordal's boy Joe, of sending the youth first to college and then into the shop, or vice versa. But in cases where there is a scarcity of greenbacks the problem is an entirely different one. Where one boy has the advantages of means to pay for his industrial training, half a dozen have nothing but their own perseverance and ability to fall back upon. The root of the difficulty is not, as some of our literary exchanges would have the public believe, in the opposition of trade unions to the entering of more than a certain number or proportion of apprentices in each shop. It arises from the changed systems of doing mechanical work. Only a part of the men who work in machine shops are machinists. It takes but a short time for a man or boy to learn to feed an automatic machine, and very few proprietors care to take apprentices for the purpose of teaching them all the different manipulations of the machinist's trade. As an example of "how not to do it," we take the following from a communication to *Design and Work*, of London:

On inquiries being made as to a youth entering large works, the reply generally given is, "Are you going to enter as a 'pupil' or as an 'apprentice?'" Now the premium for a pupil averages from £200 to £500 for five years. The peculiar (so-called) advantages of being a pupil are that he may come to work when he likes, go away when he likes, and work or not as he pleases. He is looked upon by the foreman as a "young swell with more money than sense," and he (the pupil) thinks it quite beneath him to speak civilly to the workmen. How then can we expect him to work with them? So the men despise him, and the foreman will not put himself out to give the pupil any practical information. The youth serves his time of five years, merely walking up and down the shops, and if the day is not too hot he may do a little bit of work; but when he gets warm he puts on his coat and goes out for an airing! Thus the advantages of a pupil may be summed up in a few words. They pay a heavy premium, and do no work; consequently pick up no practical information. How can we expect large engineering works to be carried out in a practical way by men trained in this manner? Of course, there are exceptions to every rule, and so in this. There are pupils—one or two I know personally—who, though their parents did pay a very high premium for them, were not ashamed to work, and were at the works every day at six, and worked steadily on, received information from the foremen, and their employers were satisfied with them. But, they tell me, if we only had the premium (so foolishly paid) *now*, "we might get on in our profession;" and it is true in these hard times brains alone cannot give us work to live by—we require some gold as well.

An apprentice pays, as a rule, a premium from £50 to £100 for five years—sometimes nothing. His advantages are, that he must be at the works by six, and must work steadily all work hours, and if he does this the foreman will appreciate him and help him in every way. His work consists generally, to begin with, in filing up any piece of iron, no matter whether he spoils it or not; then he is put to a drilling machine, then to any other small machine vacant, and in time he is put on the "benches," where all the fitting is done, and from there to the erecting shop, where the machines are put together. From there he, as a rule, goes to the drawing office, finishes his time there, and when he leaves the works thinks himself worthy of the name of engineer. I may state that the above was my own experience in one of the English railway works, and I may say that I was bitterly disappointed with the system of teaching apprentices. To make a youth a practical man he should learn thoroughly the handling of tools, fitting, turning, moulding, pattern-making, casting, the principles and management of machines; and we cannot expect him to learn this unless there is a practical man at the works to teach him, not only the practical work, but the theory as well. If this were done the premium of £100 would not be wasted, and the student would not have to consume so much of the "midnight oil" in learning the theory of engineering and general book knowledge necessary. It is by working so late at night with their heads, after a hard day's manual labour, that so many young fellows injure their health, and are obliged to give up the study of practical engineering altogether. Fancy getting up in the morning at 5.30, and going to bed at two a.m.—three and a half hours' sleep! and I know one or two students who have done this, and have injured their heads by so doing. Surely this ought to be remedied, and I believe if in large works a practical man is paid to teach these students the theories, &c., we should be able to look forward to the day, when students, leaving the works and obtaining employment, will be tried and not found wanting either in theory or practice. Englishmen must look out now, for foreigners are beginning to carry the palm. Without trespassing on your valuable space, I may state that students should give their preference to small works, where "general work" is done, as more attention will be paid to them there, and they will have more varied work to do, and consequently gain more experience than if they go to works where only one description of machine is manufactured.

The Corrosion of Iron and Steel.

Sea water in itself, uncombined with air, is not so corrosive as river water, but in its usual combination, its better conductivity of electricity serves to make it more corrosive, as it is well known that electrical action always takes place between a metal and its oxide, when surrounded by a conducting medium. Corrosion is not merely an action of oxidation, though largely dependant upon that, for analyses of "rust" on iron bridges, by Prof. Calvert, show traces of ammonia and carbonate of lime, besides nearly one per cent. of carbonate of iron. This latter product is formed to a much greater extent in boilers for non-condensing engines where hard water is used.

Nature seems to have formed the principal iron ores (oxides) to some extent from implements that have, ages ago, actually been in use; and she seems to continue this work on all iron structures that are unprotected. The worst kind of "false construction" is to rely for the support of stone and brick structures upon unprotected and oxidizable metals. It is quite important to note that in many instances it is not nature alone that produces this corrosive or decaying effect; railway bridges, for example, exposed, as they always are to the action of sulphuretted smoke from locomotives, slowly but surely unite with that element which iron puddlers so strive to eliminate.

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The Business Outlook.

Every prospect is favorable for a continued active business during the remainder of the present year, notwithstanding the fact that a great many extraneous business expectations have not been fulfilled. Almost every productive industry is active as well as every legitimate mercantile pursuit. Not a few mills, shops and factories have made enlargements, and a good number of the other portion are working more hours every day than they ever did before. The aggregate amount of failures for the first six months of 1880 was less than half that of the same period in 1879. Commercial prosperity seems to have come to stay—at least for more than a temporary season. The fact that prices of some iron and metal goods have recently declined does not depress trade as it would have done a year ago. It would now require more than ordinary fluctuation in prices to upset confidence in the cheerful future business prospect.

But we fail to see, as many of our daily and weekly exchanges would have their readers believe, that business men have grown more careful and economical, and that, taking warning from the disasters of the last seven years, they generally avoid speculation and the credit system. This view of the situation is not borne out by facts. While some business men have become more cautious, others have grown reckless and speculation and extravagance are extending instead of being checked. The credit system is pursued as confidently as it was before the panic. We know of manufacturers who build steam engines and sell them on *five years credit*, taking a mortgage for security. As incomes are swelled so are extra expenditures. The fashionable hotels and summer resorts are becoming more crowded than in any other season in the history of our country. Fancy prices are paid for about every thing offered at these summer retreats, and economy does not seem to enter into the calculations of the guests. The most costly dry goods are in far greater demand than for years before, while fast horses, high priced jewelry and luxurious house-furnishings are more and more sought after. Mining and railroad stocks are bought and sold "on a margin" by thousands who never before had the means to risk in such ventures. Wildcat corporations flourish upon the development of the spirit of speculation, and the number of their victims grows larger instead of smaller. Attempts to get rich hastily, without hard mental or manual labor, are by no means rare. Improvement in business will always be accompanied by an increase of extravagance and speculation.

The Merchant Marine Problem.

So much is said to little purpose regarding the restoration of American shipping interests, that a little plain speaking in this direction may not be amiss.

The free register privilege, that is so confidently advocated in influential quarters, is a privilege valuable, perhaps, to the mercantile, but not at all valuable to the mechanical interests of this country. The privilege of buying ships in other countries, and sailing them under the American flag, may help the trade in American bunting, but, from any other distinctively American standpoint, it possesses little more than a statistical value to the workers of the national hive.

It is possible that the construction of new ships in our shipyards might, in time, result from the permission to buy marine junks in other countries, and hoist the stars and stripes over the shaky craft that would be most likely to change their nationality in this way, but the probability of such a result seems not very obvious.

The idea of allowing a rebate duty upon ship materials imported into this country does not, by any means, meet the requirements of the problem to be solved. That new ships would be likely to result from such action upon the part of our Government, there is little doubt, but the simple putting together of cut and dried foreign materials, is not construction, nor would a system of protection, relying exclusively upon such means, be worthy of the name of protection, according to our American ideas.

The idea of direct subsidies to steamship lines, without stipulated return, is unbusiness-like and un-American, and tends directly to wire pulling, lobbying, and other grave abuses.

But when the important place that protection to home industries holds in this country is considered, the fact is plain that nearly everything that enters into the production of ship materials, or the construction or operation of ships, is protected by tariffs, more or less stringent, all directly influencing the price of labor as well, and this important fact should be taken into patriotic and judicious account.

Let the National Legislature model its action after the sensible procedure frequently adopted by American towns and cities in inviting proposals for buildings or public works, which stipulates that estimates from *resident mechanics* only will be entertained, and the problem is solved so far as a great and growing steamship marine is concerned. The Government is in the business of providing mail service for its citizens with all parts of the world. Let it be enacted next December that, beginning twelve months thereafter, all new contracts for carrying the United States mail to prominent foreign distributing ports, shall be awarded for the next ten years only to vessels sailing under the American flag, and American enterprise will have the vessels built in American shipyards and running within the time. It is true, the Government would have to pay more than at present for carrying the mails; but the Government should afford to marine interests something like the measure of protection that it accords to every other interest.

To say the least, a quarter million dollars each per annum paid to a dozen new American steamship lines for carrying the United States mails, while it might increase the expenses of the mail service a million or so yearly, would be quite as well spent as if it were squandered in the vain effort to put water into West Virginian rivers, where Nature never meant to float a hull or lodge an anchor, and would set in profitable motion a thousand furnaces and factories, employing hundreds of thousands of workmen in the various lines that go to make up the finished steamship. These workmen would be paid good wages, and would be liberal consumers alike of Western and Southern produce and Eastern goods.

Furthermore, contracts for mail service awarded upon this fixed and simple plan would not be open to the taint of lobbying, as lobbying would be unavailing and unnecessary. The difference between granting a direct money subsidy to, or withholding it from the Smith, Brown & Jones Steamship Company, as an individual corporation already in existence, and awarding a profitable contract under fixed conditions to the lowest bidder among corporations which choose to form with a view to meeting those conditions, is wide enough to be thoughtfully considered by American mechanics, as well as American merchants, and to such we heartily commend the subject.

How much or what manner of protection for sailing vessels can be devised, is quite another problem. Steam must, in the nature of things, more and more largely supersede sail, and iron must supersede wood. On this view, the wooden shipyards would probably find their best remedy in the wholesale change to iron shipyards, that would result from following the plan here indicated.

A Canadian Opportunity.

The city of Montreal, Canada, from the long and narrow shape of its business and residence portions, like Manhattan Island, with Mount Royal park and mountain lying close alongside, would afford an excellent opportunity for an elevated railroad on the New York plan to become both useful and profitable. An inclined plane railroad that would render the magnificent mountain park accessible to the poorer denizens of the Canadian metropolis, would also be a good speculation. At present the park seems designed only for those who are able to visit it in carriages. Montreal is American in so many respects, that we commend these suggestions with some confidence to our friends over the border.

A Mechanical Circus.

The circus has sometimes laid claim to be a moral educator, but until the present season we have never seen a circus poster presenting the show as a mechanical educator. The progress of popular mechanical ideas, however, is so rapid that even a circus has been fitted up with a mechanical department, so that parents who have children possessing a taste for mechanism will not now be obliged to wait until the opening of the industrial exhibitions in the fall to gratify their young hopefuls with displays of interesting mechanical inventions in actual operation. One of the dozen or so "colossal aggregations" that are now tearing through the country "on a scale of unequaled magnificence" has scattered broadcast flaming showbills to draw attention to its wonderful attractions.

It descants upon the usual pageant of golden chariots, which dazzles the small boy in its triumphal march through the streets. Then the bewildering feats of the trained elephants are glowingly pictured. Language almost fails to describe the antics of "the intrepid, daring, dashing, beautiful and incomparable" Miss Blank, who rides fiery, bare-backed steeds, jumps through fire balloons, and "performs an incredible number of juggling feats."

But the culmination of attractions is reached in the Brush electric light, and a real steam engine and boiler. Attention is called to these rare features of a circus in the following paragraph:

"The light in use by us requires a thirty horse-power steam engine, a forty horse-power boiler, making 900 revolutions per minute. We have eighteen electric light chandeliers, connected by 28,000 yards of insulated telegraph wire, forming an uninterrupted and continuous circuit, with an illuminating power equal to 35,000 gas jets, giving a brilliancy light as day, sufficient to easily discern the smallest object at a distance of two miles from the light proper. The effect of this marvelous invention is incredible; its wonderful brilliancy is indescribable."

Here is enough to make the most lethargic visitor open his eyes in wonder. Whether it is the boiler or the engine, or both, that make nine hundred revolutions per minute, makes but little difference in the degree of astonishment with which this must strike an engineer witnessing the performance. Even our esteemed contributor, Mr. Charles T. Porter, who is supposed to have built the highest speeed engines now running, would be amazed to see one making 900 revolutions a minute. But our suspense is relieved by a bright-colored lithographed poster, giving a view of the engine with the information that it was "built expressly for us by the Fitchburg Steam Engine Co.;" and the fact is present to mind that this company, although building high speed engines, would never undertake to produce one of lightning speed, unless it be for a circus. The display of the electric light and the engine in operation, we feel assured, will prove about the most valuable part of the show. Now, let some rival circus outdo this progressive one in the season of 1881. Put in more machinery and fewer clowns; turn some of the gilded chariots into portable farm engines, and get a few automatic machines to manufacture pins, buttons or other familiar articles as part of the show. Thus, in time, the circus may become a rival to industrial exhibitions, and compel some of the latter to provide fewer circus attractions and more mechanical displays.

1881 EXHIBITIONS.—During 1881 no less than five exhibitions will be held at Frankfort-on-the-Main, viz.: a patent exhibition, a horticultural, a balneological, an industrial, and a tanners' and furriers' exhibition.

Exhibition of Gas and Electrical Appliances.

The Philosophical Society of Glasgow, Scotland (which was established in 1802), have issued a circular and prospectus of a proposed exhibition of apparatus for the utilization of gas, electricity, etc., to be held in that city from Sept. 28th to October 25th, of the present year.

The range of subjects to be illustrated by the exhibition will include apparatus, appliances, models, or drawings that relate to, or illustrate, any of the following, namely:

1. *Coal-Gas.*—Its manufacture, purification, storage, distribution, regulation of pressure, and measurement. Its utilization in lighting, heating, cooking, ventilating, and as a motive power. Photometric testing of gas or other sources of light. Residual products of gas manufacture, coke, tar, benzole, analine dyes, ammonia, salts. etc.

2. *Oils, Oil Gases, Candles.*—Their manufacture and use for lighting, heating, cooking, and motive power.

3. *Electricity.*—Its generation and application for lighting, telegraphy, motive power, etc.

4. *Hydraulic Appliances.*—Motors suitable for comparison with gas-motors, and apparatus for the measurement and regulation of the flow and pressure of water.

5. *Architectural Appliances.*—More especially those which relate to lighting, ventilation, heating, and lightning conduction, and architectural iron-work and sanitary appliances, such as can be exhibited in the open grounds.

6. *Miscellaneous Apparatus.*—Gas-lighted buoys, fog horns, miners' safety lamps, fire-damp indicators, and apparatus for lighthouse illumination, ventilation of mines, &c.

A catalogue will be published at the opening of the Exhibition, which will contain brief descriptions of the articles on exhibition, with their price. Applications for space will be received up to August 2d. Driving power will be furnished by the gas and other engines in action. Exhibitors of motors in operation are bound to supply power without charge to the limit of their capacity. Information may be obtained from Mr. John Mann, C. A., Secretary of the Society.

An editorial in a recent number of the *Investor's Supplement* raises the following wail for the oppressed:

"We cannot here refrain from commenting upon the results of the policy of repression now so generally applied to the railroads. No sooner does a railroad advance to a paying basis than it is thought a fit subject for interference. Those natural rights that are allowed to obtain in the case of every other class of corporations are denied to railroads—we were going to say to railroads alone, but no, banks also come in the same category."

It is to be lamented that the unprotected condition of railroad corporations and banks has not sooner been brought to public notice. It is time to wake up public sympathy in their behalf right away. Let indignation be aroused against the enemies of "those natural rights." Down with "policy of repression." If a railroad wants to squeeze one town through which its line runs, by virtue of a strong charter from the State, to divert trade to another town, let an outcry be raised against a meddlesome legislature that attempts to prevent it. If a railroad company waters its stock freely let the press, "the bulwark of our liberties," not remain passive if the "policy of repression" is applied. If any repressive legislature dares to threaten "those natural rights" by which banks escape taxation on their accumulated cash let it be proclaimed that such acts threaten the wages of workingmen. It won't do to be too moderate about such things. But then moderation is a complaint that does not trouble railroad and banking corporations. What they want is to be let alone to operate without "repression."

An arrangement has been made by the Great Eastern Railway for transporting large quantities of sea-water to London. They are said to be overrun with orders.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) F. B., St. Louis, Mo., writes: You state in the AMERICAN MACHINIST about patent law: that any person can get drawings and specifications of any patents, one for twenty-five cents, twenty or more for ten cents each. Does this mean twenty of the same kind or twenty different patents? I want to send for some to see what has been done in a certain line; I want to get up some machine. Will they send them free of postage, or must I pay that to get them? *A.*—You can select copies of patents at will, either one of each issue, or two or more of any single issue. By sending $2.00 to the "Commissioner of Patents, Washington, D. C.," with the request for twenty coupons, you will receive them in a few days. Thereafter, in writing for copies of patents, enclose one coupon for each copy. They will be sent free of postage. When you have purchased these coupons (costing ten cents each in lots of 20 or more), you can send one of them for a single copy of a patent, or send as many of them at a time as you wish copies of patents. If you have no coupons and send money for less than 20 copies of patents you must enclose twenty-five cents for each copy. The Patent Office is conducted for the benefit of the people of the United States, and a letter addressed to the "Commissioner of Patents, Washington, D. C.," on business connected with office will receive proper attention. When the letter concerns a patent, it should state the name of the patentee, the title of the invention, and the number and date of the patent. A separate letter should, in every case, be written in relation to each distinct subject of inquiry or application.

(2) S. M. K., Franklin, Pa., asks: 1. Will you be so kind as to inform me of the best method of lining a cylinder with brass, vacuum tight? Size of cylinders 24"×24". *A.*—The best and cheapest method of lining cylinders and air pumps of 30" diameter and less, is to procure a piece of sheet brass of the thickness required for the lining. The width of the sheet should be equal to the length of the cylinder, and the length of the sheet should be equal to the circumference of the bore of the cylinder. Before lining, the cylinder should always be bored out, and the sheet referred to should be carefully rolled to the exact diameter of the bore of the cylinder. The ends of the sheet should be a short distance apart and not parallel, in order that a key, made from the same material as the lining, may be inserted, which, when firmly driven home, will securely hold the lining. If the lining has been carefully rolled and carefully handled there will be no necessity of boring it out, it being smooth and true enough without it. 2. What will be the best kind of packing to use therein to counteract hot salt water? *A.*—The piston and rod for the cylinder or pump should be made of composition. The piston should have a groove turned in it, or what is better and more generally used, a follower upon the top side held in place by bolts. The packing should be of hemp well picked apart, which after being plaited should be saturated with tallow and wound tightly around the piston in the groove referred to, so as to make a tight joint. The edges of the groove at the bottom, instead of being square as for packing rings, should be well rounded so as to better fit the packing.

(3) E. E. E., Pottstown, Pa., asks: Is there any relation between the sizes of the object glasses and the eye glasses of a telescope, and what should be the length of focus of a three (3) inch objective, and the size of eye glass, of a telescope having a three inch object glass? *A.*—There is a very intimate relation between the size of the object glass and eye piece of a telescope; and the eye piece to get the best results, should always be proportioned to the size and quality of the object glass. The focus of your object glass can only be determined by inspection as merely the size does not convey any definite information to enable one to judge of the length of the focus. To enable you to understand we will suppose the telescope to represent a "Cyclopean eye," of which the object glass is the pupil, because by its aid all the light which falls upon the object glass is brought to a focus on the retina, provided that a sufficiently small eye-piece is used. It is understood that a portion of the light is lost in passing through the glasses. Since the quality of light which falls on a surface is proportioned to the extent of the surface, and therefore to the square of its diameter, it follows that because a telescope of 1" clear aperture has five times the diameter of the pupil, it will admit twenty-five times the light. A 6" will admit nine hundred times the light which the pupil will, and so with any other aperture. For this reason a star viewed through a telescope appears brighter than to the naked eye in proportion to the square of the aperture of the instrument. In order that all the light that falls upon the object glass may enter the pupil of the eye, it is necessary that the magnifying power be at least equal to the ratio which the aperture of the telescope bears to that of the pupil. The latter is about one-fifth of an inch. We must therefore employ a magnifying power of at least five for every inch of aperture or we will not get the full advantage of our object glasses. For instance if to a 24" telescope we attach an eye-piece so large that the magnifying power was only forty-eight, and pointed it to a bright star, the "emergent pencil" of rays from the eye-piece would be half an inch in diameter and the whole of them could not possibly enter the pupil. We would recommend that you read up a work on the telescope and microscope by Dick, which will give you all the necessary light you may further require on the subject.

(4.) L. H. K., Pittsburgh, Penna., writes: In No. 16, Vol. 3, April 17, page 7, you give a receipt for white shellac. Will you be kind enough to inform me how the saturating with chlorine is accomplished, or the process performed? *A.*—The expression, "saturate with chlorine," means the substances to be saturated are to be placed in contact with chlorine for a sufficient length of time to allow them to become saturated or soaked with it. Chlorine is produced from powdered black oxide of manganese, placed in a flask or retort, and strong hydrochloric acid poured upon it; afterward apply a gentle heat. This will cause the formation of a yellow gas, the atomic weight of which is 35.5, a full description of which you will find in any standard treatise on chemistry. After preparing and collecting the chlorine in a vessel large enough to contain a quantity of gas, besides the substances required to be saturated, the substances referred to are then put into the vessel, the top closed, the vessel shaken up occasionally, and observations made from time to time to ascertain how the saturation is progressing. Where large quantities of white shellac are to be prepared in the manner described in the receipt a special apparatus is much more economical, and greatly facilitates the work.

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For first-class machine work try Anderson Bros., Engineers and Machinists, Peekskill, N. Y.

Lathes, Planers, Shapers, Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. Gould & Eberhardt, Newark, N. J.

For Sale—Shapley & Wells Engine, 8 H. P., as good as new, lathe swing, 24 in. x 9 feet. T. & K., Box 246, Owego, Tioga Co., NY.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

American Watch Tool Co., Waltham, Mass. Lathes, Watch Case, and Clock-Making Machinery.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease. Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Power Shears. Stiles & Parker Press Co., Middletown, Conn.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

See Christiana Machine Co.'s adver., next number.

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Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

MANUFACTURES.

The Newark Steel Works are building a new tool shop. They have lately put in a Siemens-Martin furnace and four Sweet's Gas Furnaces, making five of the latter now in use. They employ over 250 men.

The Western Construction Co. has been organized with principal office in Toledo, Ohio, for railroad and bridge building, by Calvin Brice and others; capital $100,000.

Ed. F. Williams writes us from Leadville, Col., as follows:

Notwithstanding the fact that Leadville is situated far up in the wilds of the Rocky Mountains, more than one hundred miles from any tract of land that might justly be called a valley or plain, 10,200 feet above sea level, surrounded by regions of perpetual snow; notwithstanding the natural isolation of the locality, its remoteness from the great Eastern work shops, the engineering science of the world below us is appreciated and the highest types of machinery will shortly recieve a fair share of patronage among the peaks, rock, and cañons of this far off country. The La Plata Mining & Smelting Co., under the very able superintendance of M. E. Smith, Esq., are the first to take the progressive step; and when the result of the enterprise is generally known, it is the writers opinion that many more will follow their example, by buying first-class automatic engines in place of the extravagant slide valve throttling engines now in use. I cannot believe that first-class engines will come into universal use, for there is a class of men here, as elsewhere, whose ignorance disclaims the existence of any thing better in this world than that with which they are already familiar, and will go on using their antiquated engines, year after year, paying out double the necessary amount for fuel, unconscious in their blissful bigotry that they are neutralizing the best profits of the institution by the payment of enormously extravagant fuel bills.

Every new place, it seems, must have some men of influence to take the initial progressive step, and show the gain to be derived from advanced engineering appliances. It takes nerve and judgment, and I could not speak too highly of the managers of the La Plata Mining & Smelting Co. in this regard. The engine they were using (a throttling 14"×24") becoming considerably worn, they thought best to get a new one and keep the old one as reserve. It was indicated and the H. P. ascertained, and being advised by a mechanical engineer, a 14"×28" Buckeye Automatic was ordered, and in about three months the new engine was placed on a firm foundation alongside of the old one and set to work. A saving in fuel of more than 60 per cent. was the result. The consumption of fuel by the old engine was about five cords of wood per day of 24 hours. The cost per cord being about five dollars, the saving made by the new engine is 15 dollars per day, or about 5,100 dollars per year. In five years' run the saving will be 25,500 dollars. A moderate fortune in five years. So great a saving cannot be always accomplished, for the reason that all throttling engines are not so wasteful as the one above referred to. But there are a number of engines in this camp, built not 10 feet from Chicago, which are using fully double the amount of fuel that a good automatic, properly proportioned to its work, would use. The railroad is now running to Leadville, so that coal can be shipped here from the valleys, but there is no prospect of its being cheap enough to go into competition with wood at present prices.

The Gibbs Canton Plow Co. has been incorporated at Canton, O., by M. L. Gibbs and others, with a capital stock of $10,000.

The Marysville Woolen Mill Co. has been incorporated in Union Co., Ohio, with a capital stock of $50,000, by W. C. M. Baker and others.

The Baldwin Locomotive Works, Philadelphia, are now employing 2,750 men, all working as full time as the weather will permit. During the past half year they have turned out the largest amount of work ever done in the same time. Upward of 260 locomotives have been sent out in six months, and the orders already entered warrant the assertion, that the last half of the year will show a still further increase on what they have hitherto been able to accomplish. During August they will ship 12 locomotives to Australia, besides street motors. They have quite a number of motors under way, including four for Brooklyn, six for San Francisco and several for other cities.

The boiler of a threshing engine, at Dunkirk, Ohio, exploded, July 6, killing seven persons and wounding eight. Two of the latter have since died.

The United States Foundry Company of Chicago have recently filed certificate of incorporation with the Secretary of State at Springfield, Ill. Capital, $250,000.

The Toledo (O.) Car Trust Co. has been organized with a capital of a million dollars, to manufacture car wheels.

A party of Eastern capitalists are considering the feasibility of establishing a large cotton factory at Hokah, Minn.

Mr. George W. Childs has become a special partner ($100,000) in the firm of Hagstoz & Thorp, Philadelphia, makers of watch cases and parallel pliers.

Work upon Disston's new rolling mill at Tacony, Pa., is pushing rapidly ahead, and the new enterprise within a few months will be ready to commence operations.

The American Vegetable Fibre Company, of Philadelphia, has leased the old waste factory at Frenchtown, N. J., and will proceed to fix it up for the manufacture of flax.

Ferriot & Chassange, Akron, O., have started a new chain works. They make a specialty of chains for agricultural machines; also coil, log, wagon, trace and breast chains, all hand made.

The new works of the St. Louis Wire Mill Company is nearly completed, and it is expected it will be in full operation soon.

Conrad Schilling is making arrangements to start up a steam furniture manufactory in the city of Pekin, Ill.

At Bethel, Delaware Co., Penn., there occur considerable quantities of a garnet rock—a rather unusual occurrence. This rock is now mined and prepared in various marketable forms as a substitute for emery. As the garnet approaches topaz, which ranks next to corundum in the the scale of hardness, it is not unlikely that a massive variety of this mineral should be as hard or even harder than some grades of emery.

The Hudon Cotton Company, Hochelaga, near Montreal, Canada, is having made in Bolton, England, a mammoth 500 horse-power engine, a counterpart of one now being used by the Company. The new engine will arrive about the 1st August, and will cost £3,500, and yet such is the capacity of the mills that both the engines will be kept continuously running. The bed for the new engine is far advanced toward completion, and an idea may be formed of the dimensions of the engine when it is stated that the bed itself will cost $7,000. The Canada Cotton Company, at Cornwall, are also making important additions to their factory. A weaving shed, 240 feet long by 50 feet wide, and one story in height, is being built with a view to the reception of 200 additional looms. In aid of this the Corporation of Cornwall, a short time since, granted the company a bonus of $10,000. The number of hands employed in the new weaving house will be over 100, and the whole will be in operation the latter part of August.

At a recent meeting of the Mississippi Valley Cotton Planters' Association, at Vicksburg, it was resolved to invite the co-operation of the Chambers of Commerce and Cotton Exchanges of New Orleans, Memphis, Little Rock, and Montgomery in the arrangement of a series of fairs to be held in those places during the coming Autumn and next Spring, for the purpose of exhibiting and comparing the various patterns of agricultural and manufacturing machinery in use on the cotton plantations of the South.

A new corporation has been formed in Portland, Me., known as the Cameron-Estes Plough Company, with a capital of $300,000, of which $75,000 is working capital and $12,000 already placed. The company will manufacture the Cameron plough with the Estes improvement, the latter consisting of frictional rollers. J. H. Whitney, Portland, has been elected president. The new plow is said to be so much lighter than those now used that one horse can do the work that require two now.

Machinery has been purchased for the new Pekin Glucose Co., Pekin, Ill., and the work of building is going on rapidly.

Barker & Berton, of this city, are building a chimney for Henry Maurer's fire-brick works, at Woodbridge, N. J., 125 feet high, of octagonal shape.

The Whittingham & Hart Manufacturing Company has lately opened its works at 105 Ontario Street, Cleveland, O., for the manufacture of models, fine brass works and small machinery.

Chas. Waters & Co., Boston, made and sold 2,315 Waters governors last year. A week ago they had made and sold 2,440 governors so far in 1880, and are behind their orders. There is some prospect of their building a new factory about three miles from Boston.

A sum of £13,286 5s. has already been obtained towards establishing a technical school in Huddersfield, England, but great as is this amount, says *Design and Work*, the promoters find that a further sum of £5,000 will be required before the building, when erected, can be fitted up with the requisite appliances.

Mr. Wharton Barker, the Philadelphia banker who acted as the agent of the Russian Government in the construction of the Russian cruisers at Wm. Cramp & Sons Works has had certain concessions made to him by that government for the development of the natural resources of Russia. This includes the opening up of coal-mines in Southern Russia, the construction of a railway system from Southern Russia to the Sea of Azov, the establishment of a vast shipping port on that sea, and the erection of works for the manufacturing of Bessemer steel rails.

In March last, says the *British Trade Journal*, China placed an order in America for 20,000 000 cartridges. It seems that these were intended for weapons previously purchased. A telegram, early in June, announces that large quantities of cartridges delivered in China do not fit the weapons. The question arises as to where the blame rests. It may pretty safely be assumed that the loss will not fall on those who supplied the cartridges. We take it American manufacturers (if it is their cartridges that fail to fit) are too cute to deliver goods till cash is received.

It is an open secret, says the San Francisco *Mining Press*, that, in response to an application from the Japanese Government for a loan of $20,000,000, to construct a navy of iron steamships, several gentleman, including John W. Mackey and Irving M. Scott, offered to take the loan; that is to say, they offered to build a certain number of vessels at a stipulated sum and deliver them to the Government of Japan. The rumor further runs, that one of the gentlemen mentioned has already gone to Japan for the purpose of negotiating the loan in the manner indicated, and that if he shall be successful he will go direct to Great Britain to inspect the great iron works and ship yards, and collect the best and latest data respecting the construction of iron vessels, and that on his return here the company will at once proceed to erect extensive and complete works for the manufacture of iron and the construction of iron steamships.

Machinists' and Engineers' Supplies.

NEW YORK, July 15, 1880.

There are indications of more activity in the supply market this week. The inquiry is better and of that character which means business. There are a number of buyers in the market both from the South and West, which is strong evidence that confidence is restored and the belief is that prices will soon have an upward tendency. However, there is no change as yet.

Iron Review.

NEW YORK, July 15, 1880.

The iron market continues to improve. Inquiries from large consumers begin to increase and iron is held at higher prices. The prospects are good for an active fall trade. We quote No. 1, $23; No. 2, $22, and grey forge, $21.

Manufactured iron remains unchanged since our last report.

Pierson & Co., 24 Broadway, N. Y., under date of July 15, 1880, quote prices out of store as follows:

Iron Rails, $50 to $57, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3.6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.3c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies as follows:

Flange, 5c.; C. H. No. 1 Shell, 4c.; Tank, 3c.; C. No. 1, 3½c.; Sheet, 3½c; Angles, 3¼c. Boiler Tubes 50% discount from list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of July 15th, 1880:

The metal market has been active since our last report with large transactions both in home and foreign markets, particularly in Pig Tin. This article to-day is 21c. here, £88 in London, and $28 in Singapore, a large advance in 30 days, and an unusual condition for this time of the year, when manufacturers expect to obtain their supplies at low prices. But the statistical position of this article has been *quietly* but steadily changing both here and abroad, and the change is so material as to justify the expectation of still higher prices. Tin is evidently advancing on its merits and not speculatively.

In other metals the quotations are about the same as those last given.

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Wanted—Machinists—Six strictly first-class Vise hands and Fitters accustomed to building machine tools; liberal wages paid by Niles Tool Works, Hamilton, Ohio.

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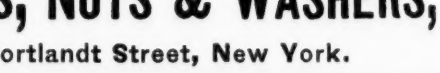

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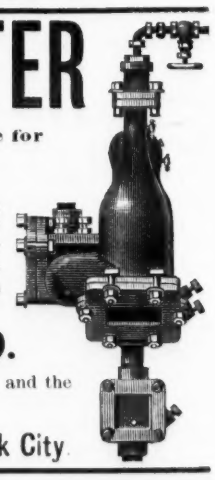

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Messrs. KEARNEY & FOOT, Brooklyn, N. Y., May 24th, 1877.

Gentlemen:—We have used your Files, more or less, for several years, and we take pleasure in saying that both the new and re-cut Files have given entire satisfaction. Yours truly,

BLISS & WILLIAMS.

FARREL FOUNDRY AND MACHINE CO.

JAS. D. FOOT, Esq., Waterbury, Conn., Nov. 8th, 1878.

Dear Sir:—Please forward the order for Files given you a few days since.

Your Files have been uniformly satisfactory to us. Yours respectfully,

FARREL FOUNDRY & MACHINE CO., E. C. LEWIS, Ag't.

We print instructions on the use of Files, and also give the diameters of round and square Files from 3 to 16 inches. They are on card board, 10x12 in., and are intended to be put up in the shop for the men to read. We are pleased to mail them to any manufacturer on receipt of the necessary 6 cents postage.

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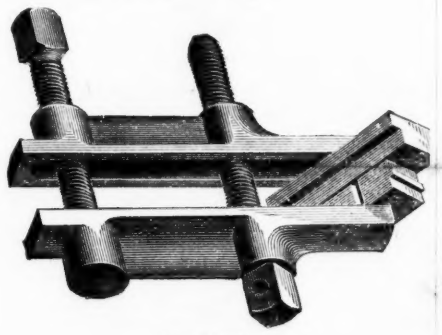

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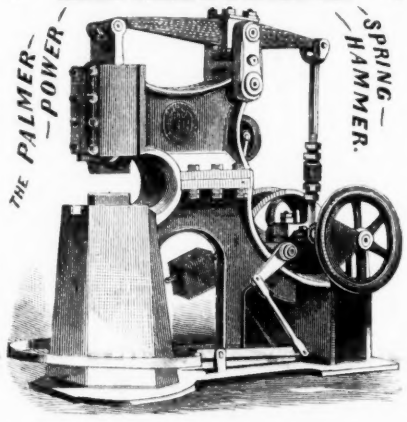

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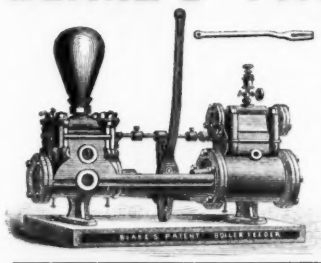

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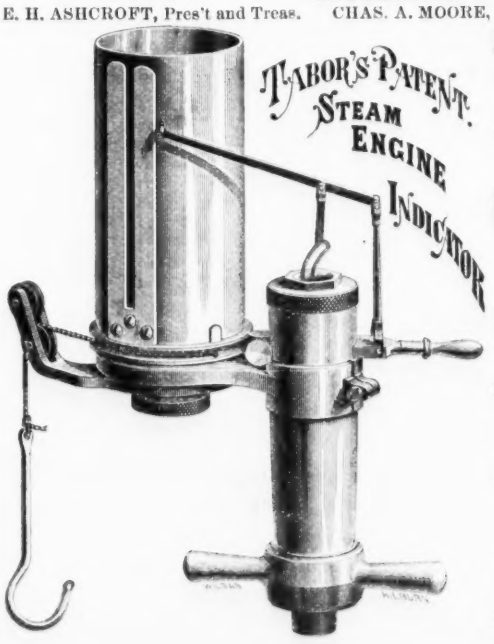

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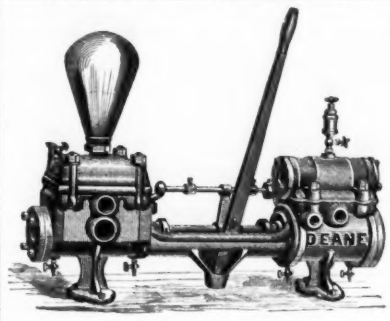

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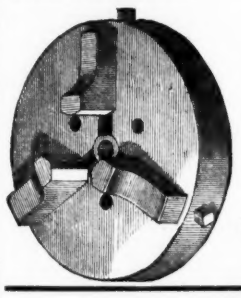

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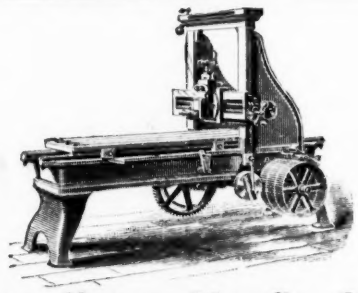

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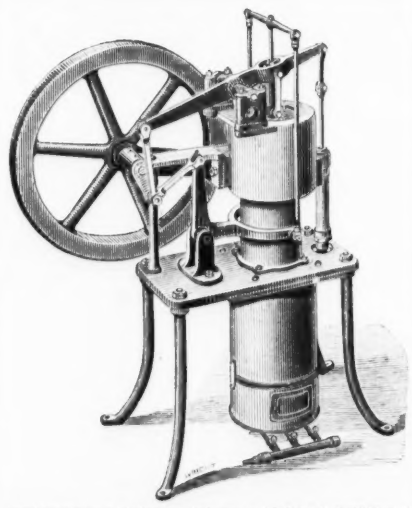

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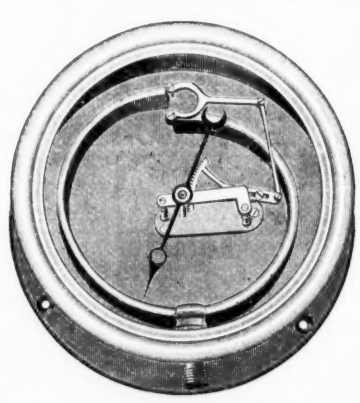

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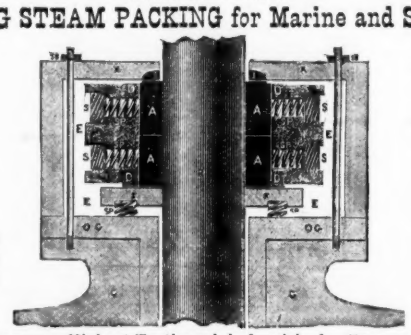

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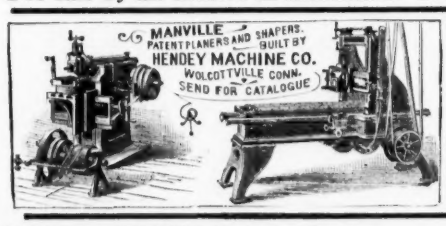

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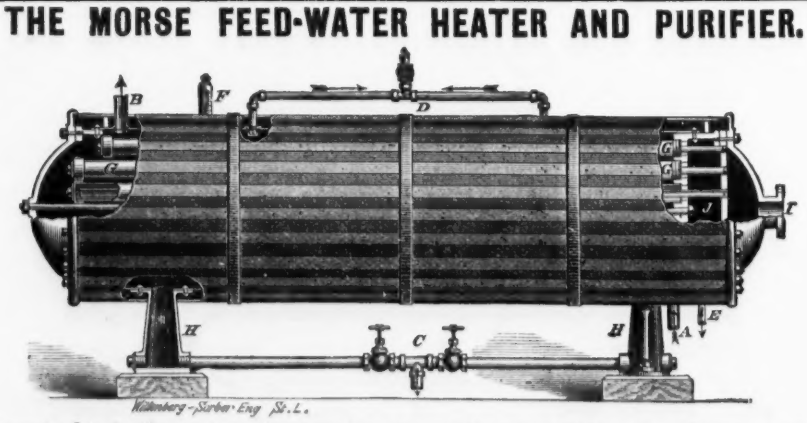

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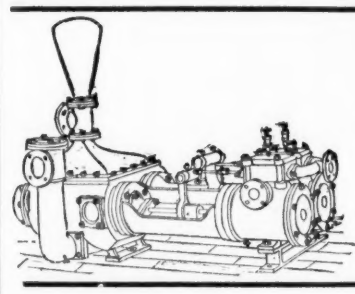

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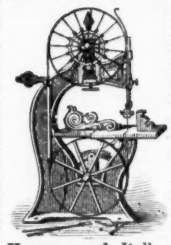

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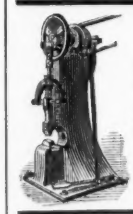

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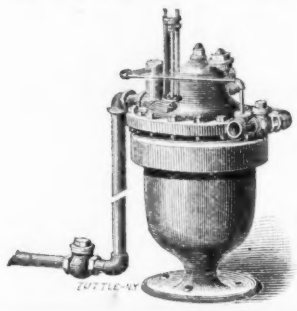

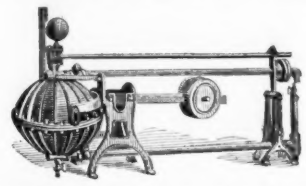

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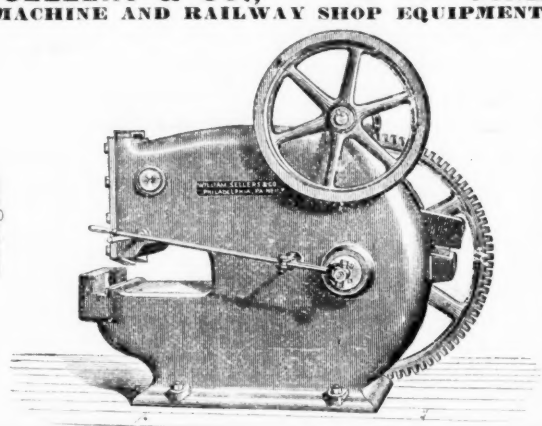

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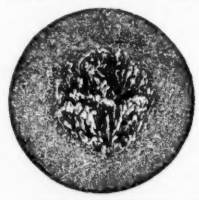

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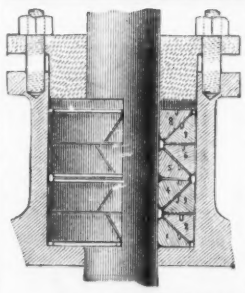

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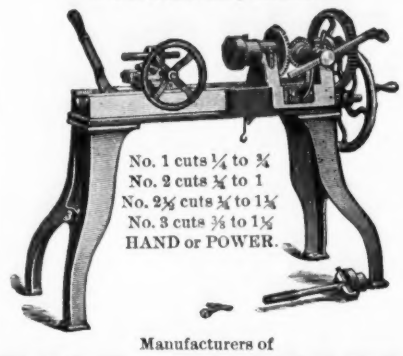

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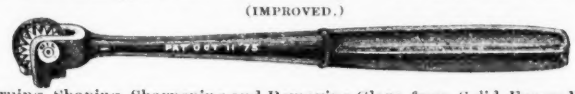

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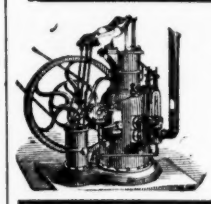

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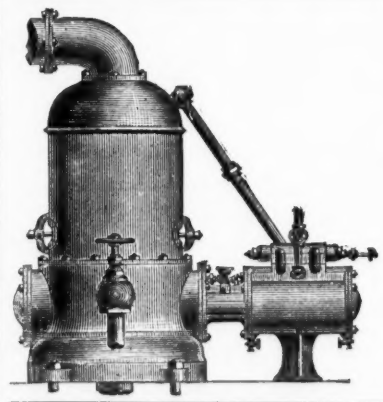

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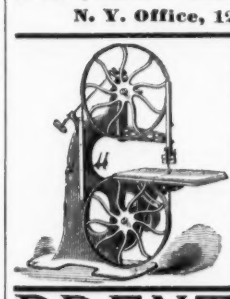

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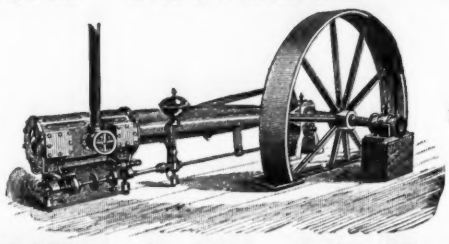

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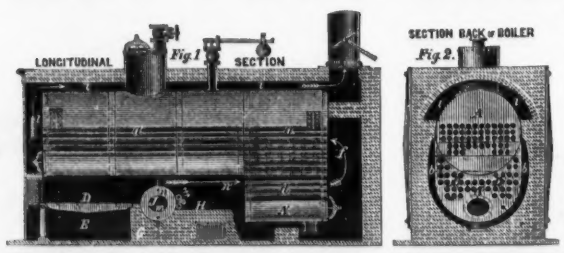

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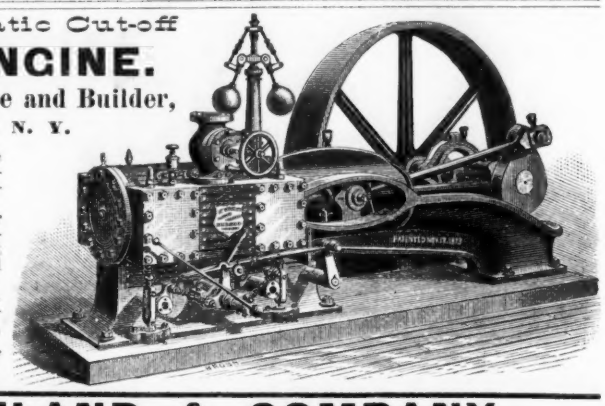

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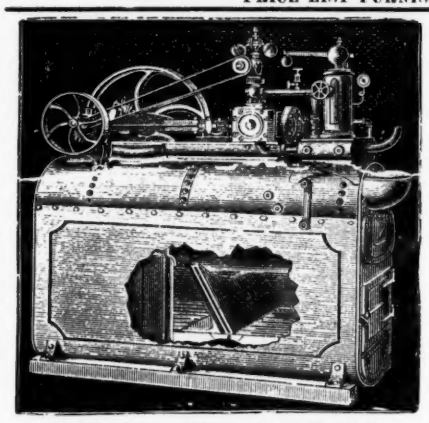

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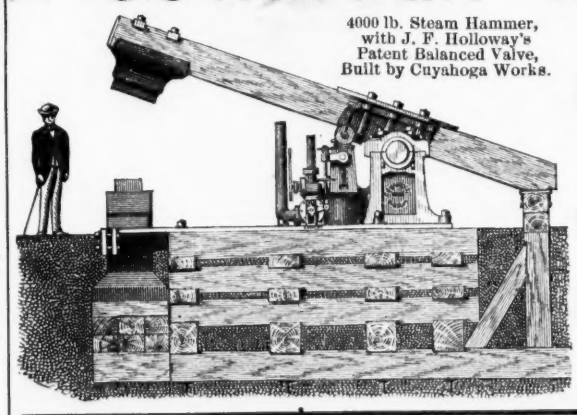

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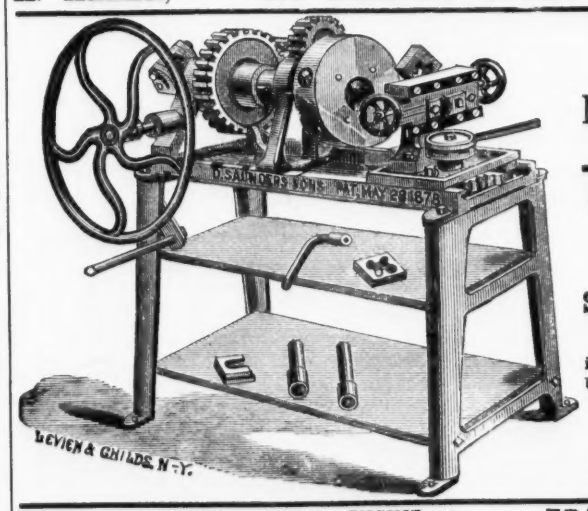

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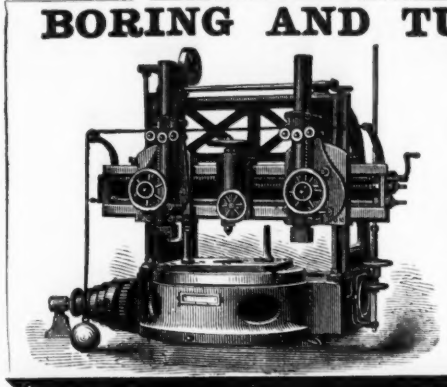

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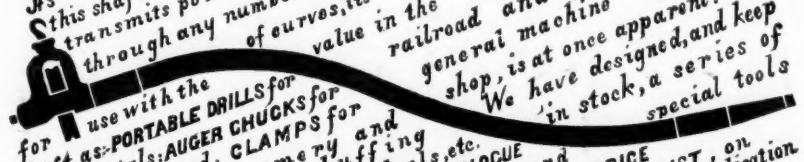
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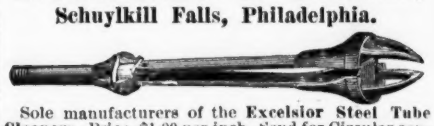

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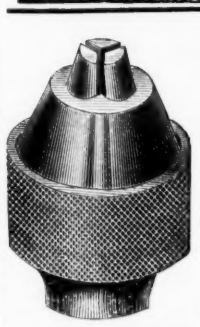

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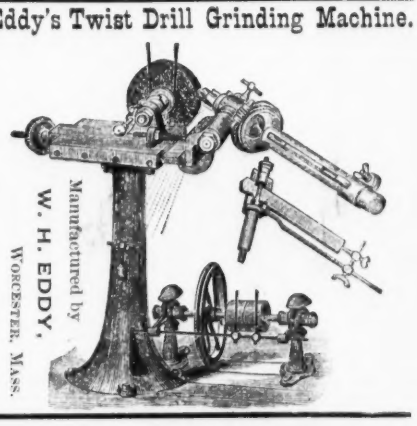

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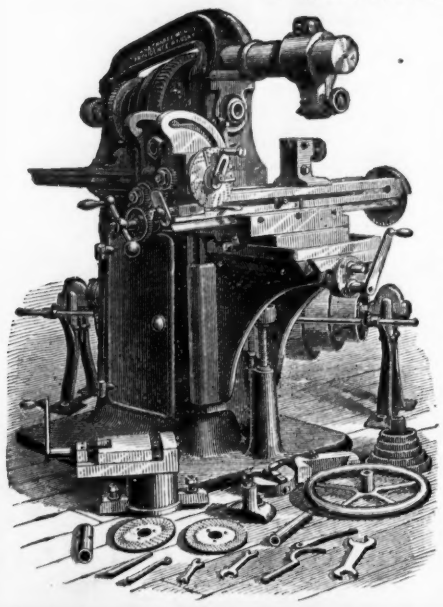

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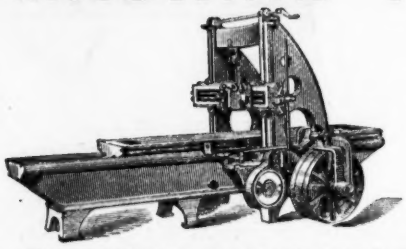

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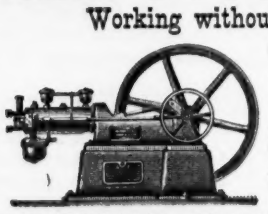

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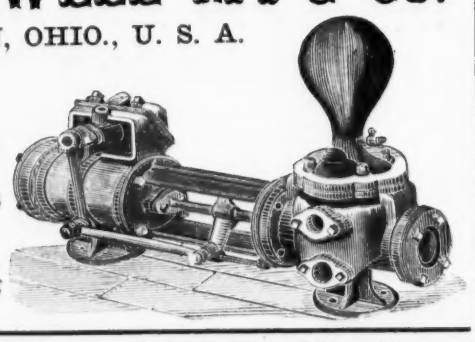

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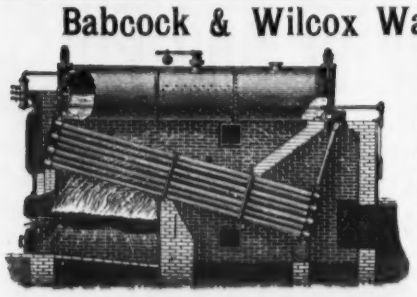

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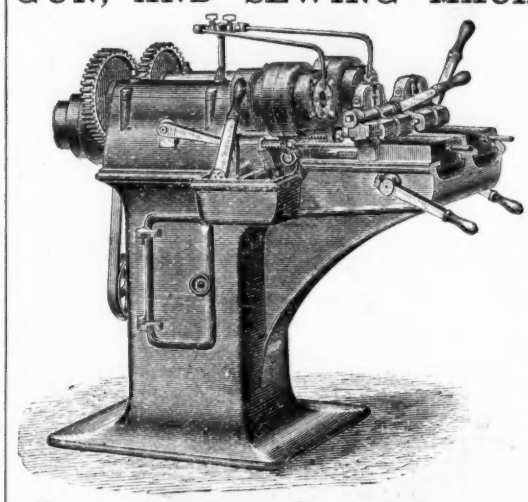

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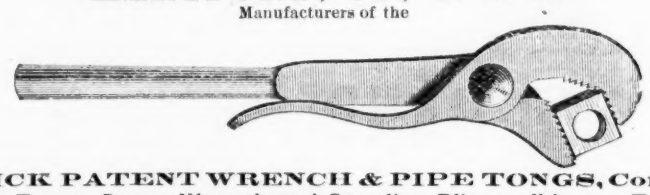

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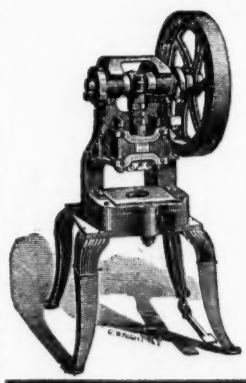

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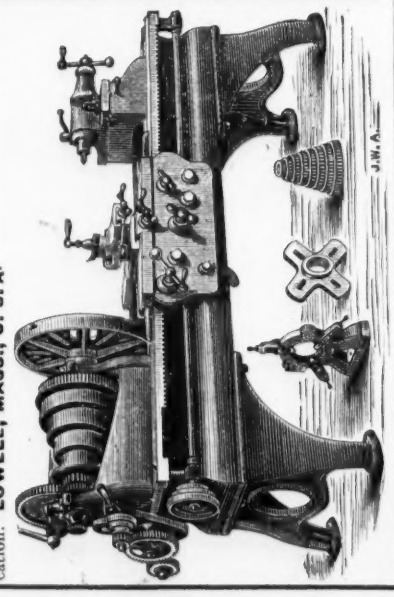

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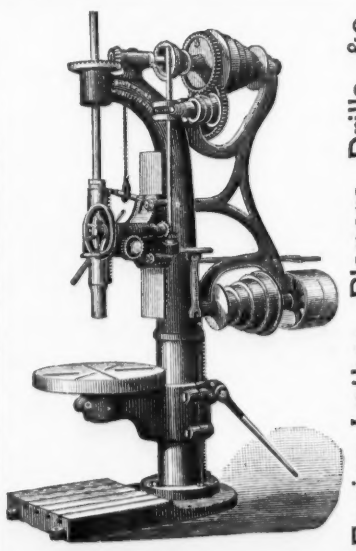

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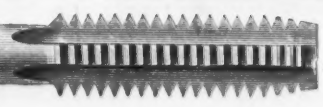

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